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MEGALITHIC MONUMENTS OF BRITTANY.

BY THOMAS WILSON.

THE term megalithic has been recognized in France as applying to the unhewn stone monuments erected by man in prehistoric ages.

The ancient province of Brittany consisted of the area comprising the present five departments in the northwest corner of France: Finistère, Côtes du Nord, Ile et Vilaine, Morbihan, and Loire Inférieure. This province is exceedingly rich in megalithic monuments—in some respects it is the richest in the world.

The man of the paleolithic period does not seem to have occupied this part of France. In only two places have any of his implements or utensils been found, and these are on the extreme eastern edge of the province. However, that is of little moment in the present discussion, for the prehistoric man of that age having made no monuments, left none.

The occupation of Brittany by prehistoric man began in the Neolithic age or age of polished stone called by M. de Mortillet Robenhausen, after the station of that name in Lake Pfaffikon, near Zurich, Switzerland. This was in the present geologic epoch and the man is supposed to be of our day.

He is supposed to have come to this country from a more or less remote east and to have wrought a revolution in the civilization of the paleolithic man who had preceded him. He brought with him a knowledge of agriculture and of grazing. He was not nomadic. He had a government or some sort of organized society. He had

not the art of the former epoch, enabling him to represent by engraving or sculpture the living things he must have seen; his art was confined to the ornamentation of his dress and the decoration by lines and dots in geometric patterns of the pottery, and afterwards the bronze, objects which he used. He was capable of long-continued plodding labor and performed herculean tasks in the construction and erection of his monuments. He had a religion: he buried his dead, depositing some of his choicest valuables in the grave with them and erecting over them monuments of the grandest and most expensive character; these have endured until the present time, and are now being bought, restored, and preserved by the state.

The names given to megalithic monuments as adopted in France are taken principally from the Breton language.

Men means a large stone.

Hir means on end.

Menhir means a large stone standing on end.

Dol means table.

Dolmen means a table of stone.

Lech means a smaller stone.

Cromlech means a circle of stone. It also has a higher signification, that of eternity, such as is symbolized by our circlet of gold, or the snake in that form, swallowing its tail.

Alignment and tumulus are modern French words, and mean, the first, lines of menhirs; the second, a mound of earth or stones usually covering a dolmen.

The megalithic monuments of France are under the supervision of a governmental commission appointed by the minister of fine arts; of this commission Henri Martin, the historian, was, until his death, and Gabriel de Mortillet now is, the chief.

The commission has authority to purchase, subject to approval, such monuments as it may deem worthy of conservation, and when purchased, they may be restored to their original condition and properly preserved. A certain sum of money is appropriated for the use of this commission. The members serve practically without compensation. The action of the French Government in this regard is in the highest degree commendable. The Anthropologists' Society of the United States might well urge upon the Gov-

ernment the adoption of similar measures for the protection of American Indian mounds and other ancient monuments against the destruction with which they are threatened.

The French commission has published a list of the megalithic monuments of France. The total number was put down at about 6,300; of these 1,600 (increased by later discoveries to nearly 2,000), are in Brittany.

They are thus classified and distributed:

Province.	Dolmens.	Menhirs.	Alignments.	Cromlechs.	Polishing stones.	Basins.	Rocking stones.	Divers.
Loire Inférieure...	50	57	1	2	.....	6	1	10
Morbihan.....	305	295	8	19	1	37	5	14
Finistère.....	170	222	9	3	.....	1	3	5
Côtes du Nord.....	112	133	.....	9	.....	.....	13	2
Ille et Vilaine.....	15	32	5	9	.....	1	.....	1
	652	739	23	42	1	45	22	32

This table would misrepresent the work of the prehistoric men of this country unless explained. While a dolmen and a cromlech count as separate monuments, each may require from ten to fifty immense stones, and each of these may be a monument in itself. So also with a menhir and an alignment—an alignment consists of many menhirs.

I will only attempt to describe the general types of megalithic monuments, though it would be necessary to exceed this to convey an adequate idea of the extent and grandeur of the monuments as a whole.

The dolmen was made in the form of a chamber or series of communicating chambers or alley-ways with sides, floor, and covers,

and was a tomb. Its floor and entrance were at about the level of the neighboring surface, and the entire monument is believed to have been covered with earth; thus in ancient times it was a tumulus.

The menhir is a single stone planted on the earth and standing erect.

The cromlech is a greater or less number of menhirs arranged in form of a circle or a square.

The alignment is the same as the cromlech; only the menhirs are arranged in nearly parallel lines.

All of these monuments consist of large unhewn granite stones. The smallest of the stones used we estimated to weigh a ton. Some, indeed many, have been accurately calculated upon the known basis of 2,700 grams for one decimetre cube, or say two tons avoirdupois for a cubic yard.

The covering stones of a dolmen have been found to weigh five, ten, twenty, and forty tons. The alignment menhirs weigh from

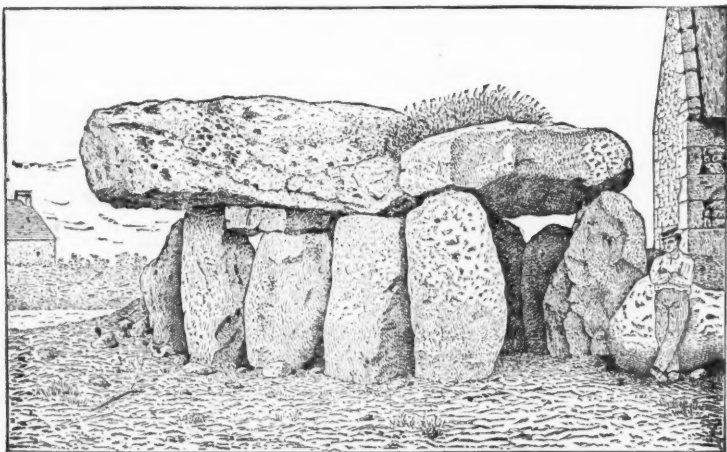


FIG. 1.—Dolmen of Crucuno.

thirty to sixty tons: two near Plouharnel weigh respectively eighty-three and ninety-six tons, the former that of Sainte Barbe and the latter that of Erdevén.

DOLMENS.

There are in the department of Morbihan about 400 dolmens, some in ruins, but many well preserved. Used for sepulture they may be described as houses for the dead. They are perhaps the earliest form of receptacle for the dead, although the Kistvaen, made of smaller flat stones with sides, ends, top and bottom shaped like a box or chest (Kist) and covered with stones like a cairn, may be older, but they may also have only been the sepultures of a poorer people.

The dolmen of Crucuno is most frequently shown to the visitor. It is easy of access, is on the road from Plouharnel Carnac to Erdeven. It is large, in good condition and presents a fine appearance. It was used as a stable before being purchased by the government. Its form, size, and condition make it a good representative dolmen.

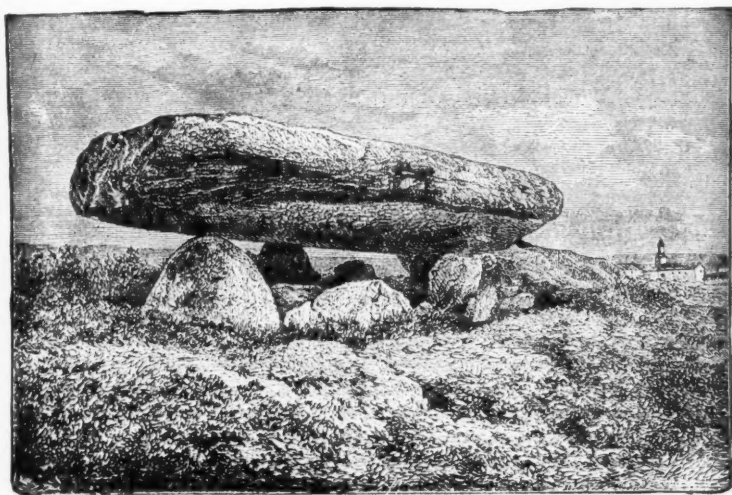


FIG. 2.—Dolmen of Lochmariaker.

The dolmen of Lochmariaker is situated near the village of that name overlooking the Gulf of Morbihan at its opening into the sea. Lochmariaker has many evidences of Roman occupation. It was on this gulf, and probably within sight of this spot, where

took place the great sea fight between Cæsar and the Venites. It has but a single covering stone bearing the form and worn appearance of a huge boulder. I do not know its exact size, but as I remember it it is twenty to twenty-five feet in length, nine or ten feet in breadth, and two or two and one-half feet thick. The chamber is rectangular, somewhat smaller than the dimensions of the covering stone above given, and is six or seven feet in depth. The bottom of the covering stone, plainly to be seen from the interior by looking upwards, is decorated with the representation of an immense polished stone hatchet or celt, with a long handle terminating in a knob. The instrument is represented in outline by a groove which has been cut, or rather pecked, into the granite surface.

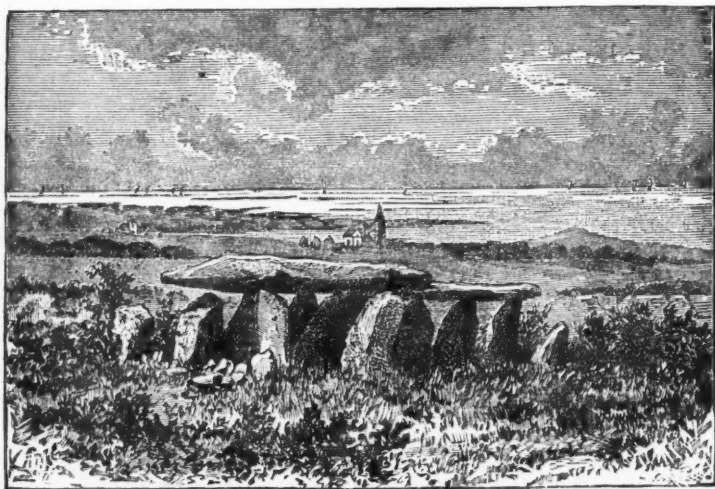


FIG. 3.—Dolmen of Grand Island. Another form.

The dolmens, usually square but sometimes round, were made in the form of chambers, sometimes as small as four by six feet, four feet high; sometimes these were sixteen feet wide, thirty feet long, and eight feet high. Most of the dolmens consist of a single chamber, but many have as many as six lateral chambers. They are made of huge flat unhewn granite stones, which are stood on end or edge to form the sides and ends of the chambers. The

covering stones (which are called tables) are large, and a single one is sometimes sufficient to cover the entire monument.

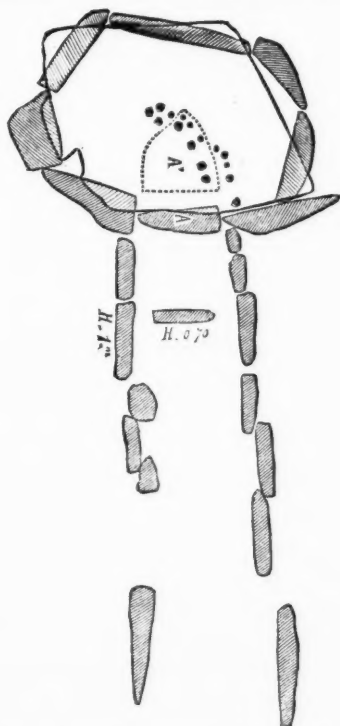


FIG. 4.—Ground plan of a single chambered dolmen, showing the stones on edge forming the gallery, chamber, and door. The light line around shows the covering stone with a group of cup markings on the under side.

The dolmens usually have a gallery or corridor leading to the chamber, made in the same way. This is for approach to the chamber. This gallery is about three or four feet wide and as many or more high, sufficient for a man to make easy entrance. It is sometimes blocked with another slab of granite at the inside and nearest the chamber, sometimes at the outside, and sometimes both. Fig. 4 will explain this. In this example the door has fallen in.

Their orientation is irregular. They open in every direction,

north and south, east and west; but there are more to the south than to the north, and more to the east than to the west. The greater number open towards the southeast. I exhibit for purposes of comparison the ground plan of several of the important dolmens (Fig. 5). It will be perceived that though they are all one general type, yet no particular or precise form has been invariably followed in their construction. Each one has its own individuality and differs from every other.

The fine, unshaded lines indicate the covering stones. The direction of the opening is indicated by letters SSE, etc., etc.

1. Dolmen of Kerlescant—at Carnac. This opens to the west. This dolmen is what is usually denominated *Allée couverte*.

2. Dolmen of Kervilor, at Trinite-sur-Mer. Opening to s. s. e., one side square and one side round.

3. Dolmen du Rocher at Plougoumelen. Opening to s. s. e.

4. Dolmen of Crucuno—same as Fig. 1. Opening s. e., chamber rectangular.

5. Dolmen of Keroed-Kerzu, at Crach. Opening east, circular chamber.

6. Dolmen of Ben-er-Groah at Lochmariaker. Opening south, two successive, circular chambers.

7. Dolmen of Kerviham, Carnac. Two chambers, semi-circular with alley between. Opening s. s. e.

8. Dolmen of Keriaval, near Plouharnel-Carnac. Three lateral chambers—opening east.

9. Second dolmen of Mane Kerioned, near Plouharnel. This is one of three in the same tumulus—side by side—opening south, and is elaborately sculptured on the face of the supports.

10. Three dolmens of Rondessec at Plouharnel, all under the same tumulus, opening s. s. e. In one of these was found a pair of gold bracelets, one of which is still to be seen at Pere Gaillard's Plouharnel.

11. Small type dolmen of Kermario, Carnac. Opening south-east.

12. Dolmen of Mane Lud, at Lochmariaker. Opening south.

13. Dolmen (with tumulus) of Kercado, Plouharnel. s. s. e.

14. Tumulus of Pornic, Loire-Inferieure, in the upper right hand corner. This contains several dolmens opening in different directions.

PLATE XI.

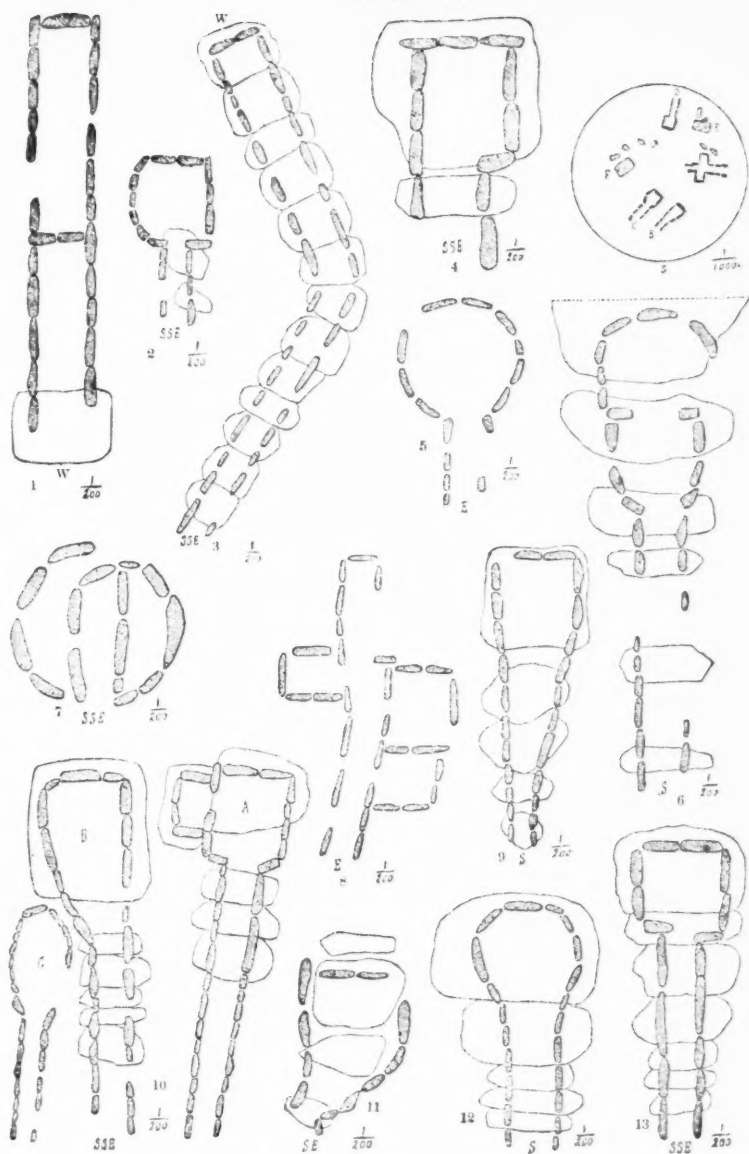
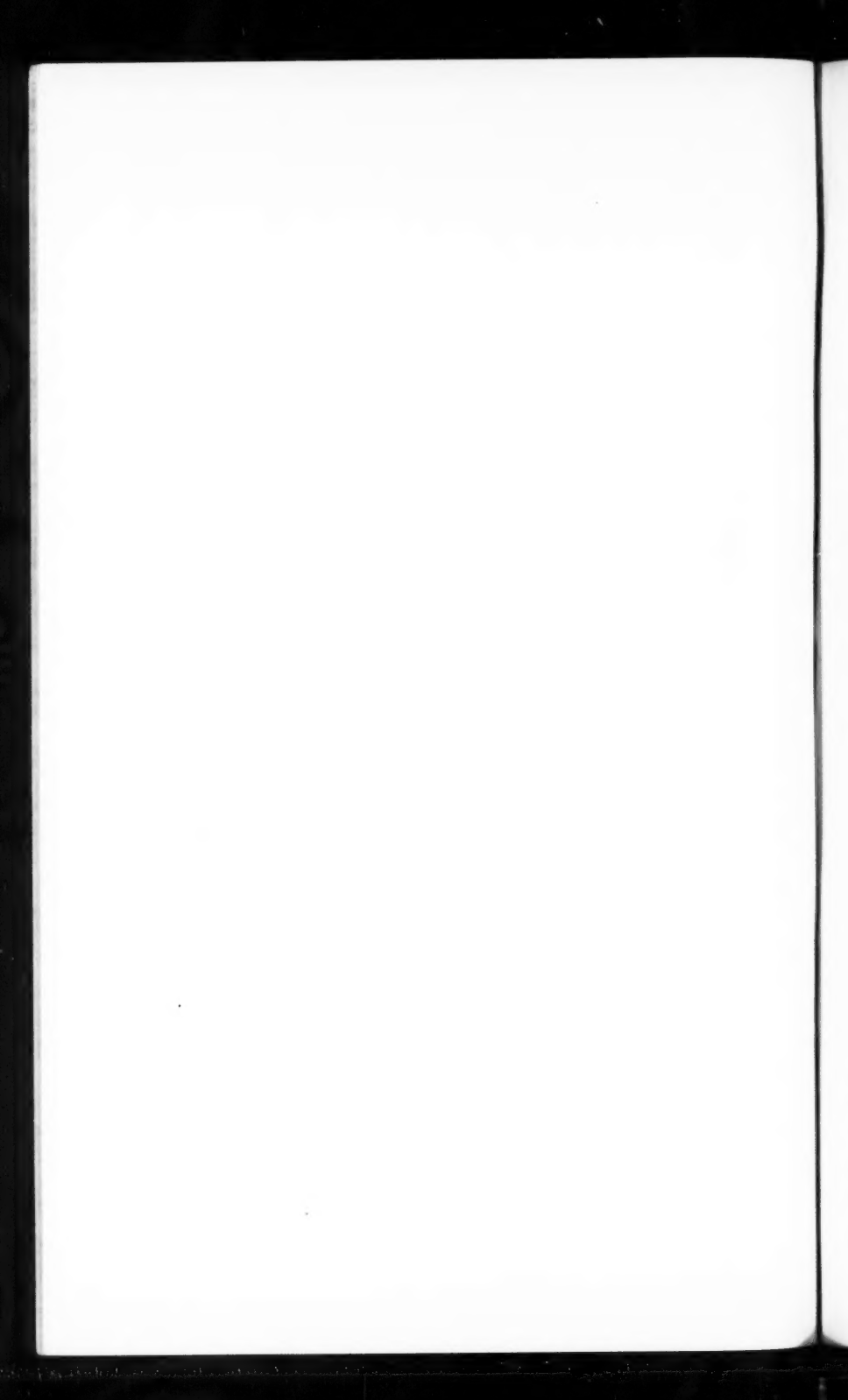


FIG. 5.—Ground plan of Dolmens in Brittany.



A opens to the east.

B and C to the south-west.

D to the north.

E and F in ruins.

It is believed that the interments were made continuously in the same sepulture (as is done partially in our own vaults), a practice which prevails to a certain extent in the country to the present day. When the dolmen (or tomb) became full, the skeletons could have been taken out and deposited in an ossuary. We found evidence of this at the dolmen of Port Blanc. It has been contended with great probability that the bodies were buried elsewhere at first and then after they had become dessicated or the flesh had been removed from the skeletons, that the bones were placed within the dolmen. M. Cartailhac has elaborated this theory with much ability. A fete day, like All Saint's, was perhaps selected for the purpose, and the dolmen may have been opened and all bones deposited therein with due ceremony. In support of this view it is argued that the skeletons have been found in unnatural and impossible positions in the dolmens; that they have been found colored or painted, which could only have been done after the denudation of the flesh, and that sometimes the entrance to the dolmen is by means of a hole cut in the stone door, so small, from sixteen to twenty inches round or oval, that the entry of a corpse would be difficult, if not impossible.

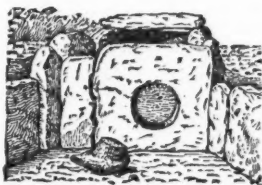


FIG. 6.—Circular hole being the entrance to a dolmen, from the department Sune-et-Oise, now removed to and exhibited at the Musée St. Germain, Paris. The round cover being in the foreground.

Excavations and searches were conducted by myself in company with the local archaeologists, M M. Gaillard, Fornier, Cappe, Rialan and the Abbe Luco. I subjoin a list of some of the larger stones in the more important dolmens, with sizes and weights.

Dolmen of Crucuno: Property of the government; the covering stones seventeen feet long, ten and a half feet wide, 30.3 inches thick; weight forty-one tons of 2240 pounds (Fig. 1.)

Second dolmen of Rondessec: Property of the government; has two covering stones both about the same size and weight, 11.6 feet long, seven feet wide, twenty-eight inches thick; has eighty square feet of surface, 198 cubic feet, and weighs fourteen and one-half tons.

First dolmen of Mane Kerioned: Property of the government; has thirteen supporting and four covering stones, one of which weighs about ten tons. Its chamber and gallery are twenty-eight feet long.

Second dolmen of Mane Kerioned: Has twenty-four supporting and four covering stones, one of which weighs seventeen tons. Its chamber and gallery are thirty-four feet in length. This dolmen has extensive sculpturing on the supporting stones forming the sides and ends.

Dolmen of Mane Groch: Property of the government; has a corridor, large central chamber and three side chambers, it has twenty-three supports and seven covering stones.

Dolmen of La Madeline: Has five supports and two table or covering stones.

First dolmen of Mane Bras: Has thirteen supports and two table or covering stones, and weighs ten tons.

Second dolmen of Mane Bras: Has nineteen supports and two tables, and weighs ten tons.

Dolmen of Kergaval: Has six supports and one table and weighs twenty tons.

It was once the fashion to speak of these monuments as having belonged to the Druids. This seems to be a tradition that has grown up within historic times and long after the Druids had passed away. The dolmens belonged as well to the age of bronze as to that of polished stone. Incineration and inhumation were both customary, but the former method pertains more to the bronze age.

There are about 3,500 dolmens in France. They are plentiful in the centre, south, and west, but rarer in the north and east; plentiful in Great Britain and Ireland, in Spain and Portugal, in

Denmark and Sweden; some in Belgium and Holland, the Rhine country, and Western Germany; none in Norway; almost none in Italy; none in Eastern Europe. The city of Dresden marks about the dividing longitudinal line.

They are found on the coast of Northern Africa, between Morocco and Tripoli; in Palestine, in Asia, in South and Central America, but not in North America.

TUMULI.

Many of the dolmens are now covered with earth, and these have been called tumuli. It is believed by those best qualified to judge, after the longest experience and closest examination, that all have at one time been so covered. One reason for this belief is, that it is universal to find the gallery, corridor or covered way, made of the same kind of stones in the same way, on the same level and leading from the principal chamber, gradually narrowing in

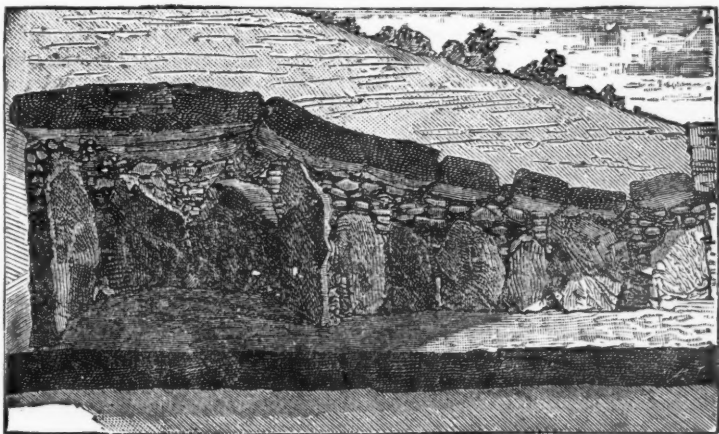


FIG. 4.—Section of a tumulus showing the dolmen with its corridor or alley-way and means of second interments.

both width and height to what would appear to have been the circumference of the tumulus. In this regard the dolmen now without a tumulus corresponds exactly with those covered by one. Some of these corridors are forty and fifty feet in length. In this way, the tomb could be covered, the monument completed and yet

the entrance be easily opened and entered upon the occasion of a second or subsequent interment.

The covering of these tumuli consists of layers of broken granite alternated with layers of clay and mud from the seashore and vegetable earth from the neighboring surface.

The tumulus of Gav'r Inis has a dolmen remarkable for the sculpturings. It is eight feet by seven, five feet eight inches high, with a corridor or alley fourteen feet long, four feet six inches wide; five feet four inches high, while the tumulus crowning it is 180 feet in diameter and was thirty feet high.

Tumiac at Arzon is 100 feet in diameter and sixty-five feet high; Manerhoeck Lochmarqueris 300 feet in diameter and thirty feet

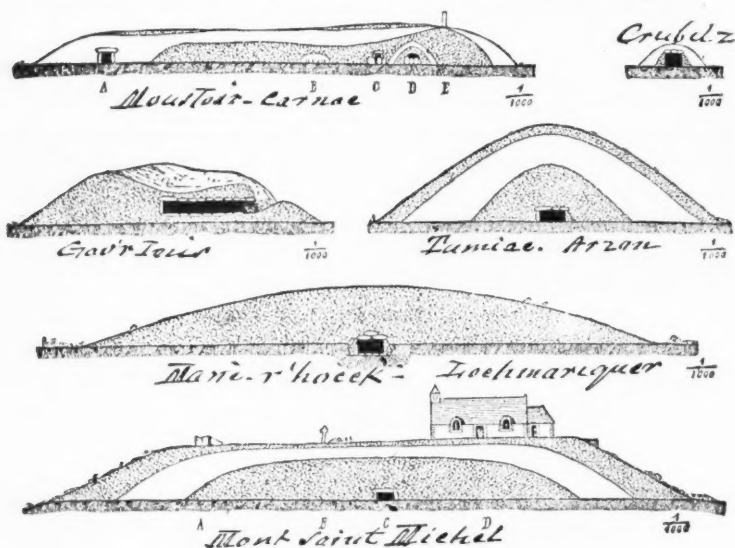


FIG. 8.—Tumuli in Brittany.

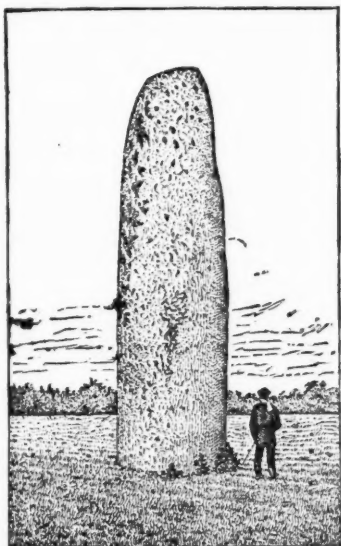
high; Mane Lud 300 feet long, 150 wide and thirty feet high; Mount Saint Michel 320 feet long, 120 feet wide and eighty high; Kerendo is about 100 feet in diameter and twenty feet high.

MENHIRS.

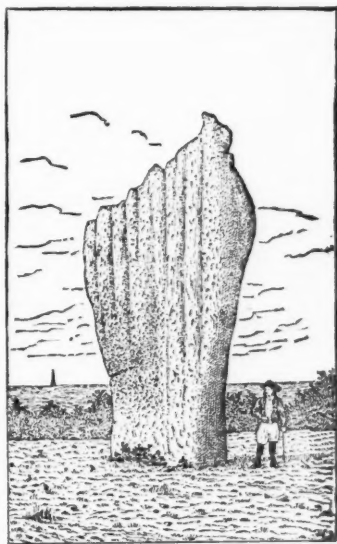
The dimensions of some of the menhirs is as follows:

Penmarch, twenty-five feet high; Cadiou, twenty-eight; Mount

Dol, thirty-one; Plouarzel, thirty-six and one-half; Plesidy, thirty-seven; and Lochmarquer, sixty-seven and one-half. The latter, fallen and broken, is thirteen and one-half feet wide and seven



Menhir of Cadion



- of Pennmarck

FIG. 9.

and one-half feet thick and weighs 347 tons. There are 739 of these in Brittany. The menhir stands single and alone. When arranged in parallel lines as they sometimes are, they are called alignments.

ALIGNMENTS.

The Province of Brittany has twenty-three alignments—one-half of those in all France. The department of Morbihan and Finistère have, together, seventeen of these. Carnac has in its immediate neighborhood six out of these seventeen. These six alignments represent 3,000 menhirs.

Menec, near Carnac, has 835 menhirs, arranged in eleven parallel lines, 3,778 feet in length and 328 feet in breadth at the head,

tapering to 200 feet at the tail. It has at its head a cromlech of sixty-two menhirs.

Kermario has 678 menhirs, no cromlech, nine parallel lines, 4,037 feet in length—same width as Menec.

Kerlescant has 258 menhirs, a cromlech square of thirty-nine menhirs, thirteen lines, 1,000 feet in length—393 feet width at the head and 164 at the tail.

Erdeven has thirteen lines, 1,120 menhirs, 6,886 feet in length, 836 in width at the head and 180 at the tail.



FIG. 10.—Alignment of Menec.

About one-half of these have been overthrown and are lying on the ground. About ten per cent. should be added for all the menhirs known to have been destroyed in modern or historic times. Without doubt the gaps now existing were once filled. This would double, at least, the number. These monuments have served as stone quarries for the neighborhood, and doubtless the great castles and churches of the early ages were built therefrom. The light house at Belle Isle was built of the granite menhirs of the alignment of Erdeven.

Thus they stand, dotting the country in every direction, enormous,

rough, rude, unhewn granite stones—great in their mightiness, mysterious in their solitude, belonging to another civilization mighty in its time, but now dead and buried in the ages of the past. They have no inscriptions, and no history. We know them to have been the work of man, and that is about all. In the case of menhirs, they rear their heads like great giants. In the alignments they stand in close array with serried parallel lines, and stretch across the level country miles away, their bodies gnawed and their heads scarred and seamed by the tooth of time since the distant ages when they were erected. It is their size, their simplicity, their number, their repetition, as well as their antiquity, which render them so imposing and so impressive. No words can convey to our mind an adequate idea of this impressiveness. They must be seen to be appreciated.

A word as to the age of these alignments.

The menhirs, whether standing or fallen, are frequently used as fences, the interstices being filled usually with an earthen embankment. In the headline, at the alignment of Erdeven, many had fallen and were thus covered with earth. On uncovering them, one four or five feet thick and ten or twelve feet long was found, hewn as it lay, for what purpose we knew not, but we could see the marks of the tool. It had served as a fire-place. There were the charcoal and stone bed and back wall, all bearing traces of fire. Pieces of flint, a small celt of fibriolite, debris of pottery, (some dolmen, but much Roman), showed that this occupation belonged to the Roman times; that is, somewhere between 40 B. C. and 405 A. D. This menhir had been prostrate from fifteen hundred to nineteen hundred years; yet it had previously stood on end long enough time for the top to become so weathered as to be plainly distinguishable from the bottom.

There is on the menhirs quarry no mark of tool or of quarrying, yet I think they were quarried. They are so much weathered that all marks are worn away. Look at the weathering on the top of the menhir of Penmarch (Fig. 6). No traces of a quarry have been discovered, though the granite of which the menhirs are formed is the local rock, coming always near and many times quite to the surface. The menhirs have evidently been planted. In most cases they stood on the surface without any foundation, but foundations had been built where needed. In many cases the smaller end of the stone was downwards.

Flint implements and chips and broken pottery are found about and among the alignments as elsewhere over the country, especially around the foot of the menhirs, showing a prehistoric occupation; but no trace of the uses or purposes of the menhirs or alignments have ever been discovered. There have been many theories broached but no facts adduced sufficient to support them. They may have been called military camps or religious or other rendezvous for the people. They may have been tents. No trace has been found of their use as burial places, and so far as established by ascertained fact, the popular idea is as near the truth as any other, viz., that they were the columns of a sacreligious invading army, turned to stone by the wrath of an offended God.

SCULPTURINGS.

Many of these stones or monuments have marks or sculpturings on them. The menhirs of the alignments have cup markings only, and these are rare. In some cases they have been marked in with crosses, modern times, made sometimes by religious devotees, sometimes by the priests, done in order to prevent or break up any chance remaining pagan custom of worshipping, or revering, or employing these stones. The dolmens are marked with various signs, none of which have any discovered signification. They have received much attention and study, but without result.

The sculptured monuments of Brittany are all near the sea-coast. Yet there is no rule and no uniformity. Many of them near the coast are without sculptures; and this is true of an entire section or neighborhood; again other dolmens in the interior will be sculptured. Do these different sculpturings represent the dwelling places of different tribes?

CONCLUSION.

The story of these monuments has never been completely told. Their condition and position may be described, and that of the skeletons and articles or implements found. It is from these details that the history is to be obtained, of the prehistoric man who made them. They must be studied with intelligence and care. Comparisons must be made with other articles found in the same place and with the same articles in other places. A full treatment

of the subject would include an account of the beautiful polished celts of jade found in the tumuli, of the gold and bronze ornaments, of the pottery, the decoration, the art, of the tools and implements of this early people which cannot be presented within the limits to which this paper must be restricted. I omit, for the present, the cromlechs, the places of incineration, the Roman remains, and many other subjects of equal interest. Perhaps at some future time I may refer to them.

DR. N. O. HOLST'S STUDIES IN GLACIAL
GEOLOGY.

BY DR. JOSHUA LINDAHL.

WE have before us two pamphlets by the Swedish geologist, Dr. Holst, of Stockholm. One of them bears the title, "*Om de glaciala rullstensåsarna*" ("On the Glacial Gravel-Osar"¹); the other, "*Berättelse om en i geologiskt syfte företagen resa till Grönland*" ("Report on a Voyage to Greenland for Geological Investigations"²). The subject of these papers has so much bearing on the geology of our own country, and is so ably treated by their author, that we have thought it desirable to present the following condensed translation of them.

In the first-mentioned paper Dr. Holst propounds his new theory of the origin of glacial osar.

The history of the development of this theory is, briefly, the following: Hisinger (in some cases), Martins, Chambers, A. Erdman, Torell, and others, explained the said formation as ancient sea-shores. Hisinger (in other cases), v. Helmersen, Törnebohm, Levin, Jernström, and others, assumed that a vast deposit of sand and mud covering the country had been cut through by rivers, whose beds were gradually filled with stones and gravel. Later

¹ Geologiska Föreningens i Stockholm Förhandlingar, 1876. No. 31 (Band III., No. 3), pages 97-112.

² Sveriges Geologiska Undersökning. Afhandlingar och uppsatser. Ser. C, No. 81. Stockholm, 1886. Pages 1-68.

the sand and mud was washed away, leaving the stone and gravel deposits of the rivers in the shape of ridges. Hummel was the first one to recognize the fact that the existence of an inland ice must be pre-supposed as the indispensable agent in forming such ridges; but he regarded them as formed beneath the ice in tunnels excavated by percolating waters. Finally, in 1876, Holst published his new theory, which in 1878 was also used by Warren Upham in his report of the geology of New Hampshire.¹ Dr. Holst's theory stands now without a rival.

The following short extract of Dr. Holst's paper may be sufficient to explain his views. He says:—

"For a correct interpretation of the origin of gravel-*osar* it is of main importance to answer the question how it was possible for running water to deposit its silt in such shape as that of an ordinary gravel-*ose*.² There can be no further dispute that these deposits are old river-beds. How, then, have they happened to assume the form of elevated ridges, rising above the adjacent country?"

The water at the surface of the melting glacier gathers in the valleys of the ice-sheet, whence it extends its coastward course in rivers whose beds are cut down in the ice-sheet. The ice along these rivers melts faster than that farther off, and in melting it gradually releases its contents of moraine matter. This matter will then follow the water, although at a far slower rate, down to the said valleys, and is finally—at least partially—swept along into the rivers, where the gravel-grains will be worn and their angles will be more or less rounded off, according to the swiftness of the current. This same factor will also regulate the assorting of the material and determine the place where each individual boulder, pebble, or grain shall be dropped. Layer upon layer will thus accumulate in the river-bed, and, when finally the entire glacier has melted away, the accumulated silt of the former river-bed will present itself as a ridge elevated above the surrounding ground; it is an *ose*.

"To sum up:

"*Osar* are formed in running water.

"No running water could lift all this matter to the considerable altitudes where we often find it.

¹ Geol. of N. H. Vol. 3., pages 14-176.

² Swedish *ås* (pronounced *ose*), plur. *åsar*=*osar*--not "osars," as it is written by some authors.

"The matter must therefore have been elevated by the ice, and must afterwards have moved down and amassed itself into osar in the above-stated manner."

In the second paper Dr. Holst gives an account of his visit to the west coast of Greenland in the summer of 1880. He went as far north as Sukkertoppen (lat. $65\frac{1}{2}^{\circ}$ N., about), extending his rambles southward to Kipissako, southeast from Ivigtut¹ (lat. 61° N., about). He traveled mostly by water, in a so-called *Umiak* (boat rowed by women), but also made excursions by foot over the inland ice, ascending some of the highest mountain-peaks for the purpose of obtaining bird's-eye views over the ice and the various pinnacles—s. c. *nunataks*—which rise out of the inland ice.

After having given a general account of his travels, the author proceeds to discuss his observations under the following headings, viz.: the ground-rock, the inland ice, the kryokonite, the moraines, the upper drift deposits, the glacial clay, and the peat. We shall here reproduce the most important parts under the first five of these headings.

A. *The Ground-rock* in the district referred to is predominantly *grey gneiss*. A bed of *hülleflint-gneiss* was observed on the peninsula to the north of Tigssaluk. More variation was noticeable east and south of Ivigtut. A rather coarse-grained, well-developed *syenite* extends over the country a little to the east of Grønne Dal; a white, pretty *quartzite*, and also what may be called a *hülleflint-schist*, were seen near the southern ice-blink at Kornok, and a somewhat similar but very fine-grained *schistose hülleflint-gneiss* occurs at Kipissako.

No granite was seen north of Ivigtut; but a limited area of granitic rock extends to the north of Kipissako glacier.

In order to get some more definite knowledge of what rocks prevail in one locality, the author collected at random fifty specimens from the terminal moraine below the Ursuk-fjord glacier. Of these 50 specimens, 12 were found to be diorite; 9 grey gneiss; 7 granite (or granite-gneiss), some grey, some red; 6 grey hülleflinta;

¹ Dr. Holst mentions, as a warning to other scientists who may go to Greenland with the intention of visiting the cryolite mines at Ivigtut, that admission to those mines is absolutely prohibited to all strangers not presenting a written permit from the head office at Copenhagen. He might have added, that such a permit is *never granted*.

4 hälleflint-schist; 3 red granite, of more than medium-coarse grain; 2 grey granite—otherwise like the last-named variety; 1 red hälleflint gneiss; 1 quartzite and 1 quartzite-sandstone; whilst the remaining 4 specimens were put down as undeterminable. In the same moraine were also noticed limestone, red fine-grained sandstone, coarser sandstone, and sandstone conglomerate, sometimes with nodules of jasper and diabas. The sandstones and quartzites are very compact, as is generally the case with older sandstones, and bear a complete resemblance to many Swedish sandstones generally regarded as *Cambrian*. C. Pingel (in 1843) expressed his opinion that they are *Permian*; and K. J. V. Steenstrup (in 1877) takes Pingel's side, and (in 1881) declares that there can be no reason for a different view as long as no petrifications have been found in the sandstone. Yet there is no more reason to regard this rock as belonging to the Permian formation than to almost any other formation. Numerous dykes of diabase are met with in the southern portions of the district visited by Dr. Holst, all the way from Kipissako to Fredrikshaab. They are particularly abundant on the Tassiussak-fjord, and not less than twenty parallel dykes of greenstone were counted within a space of five hundred feet on the island Kikertarsuak, at the inlet to this fjord. East-southeast from Grønne Dal occurs a peculiar diabase breccia, and, close to it, dykes about a yard wide of a very fine-grained red rock, microscopically determined by Dr. A. E. Törnebohm¹ as a fine-grained *syenite*.

B. *The Interior Ice-covering*.—Previous explorers of the inland ice have made the observation that moraines are found on the surface of the ice only near land, while the inner expanse of the ice-sheet is earthless, except the occurrence of the so-called *kryokonite*. What else it carries along is hidden more or less deeply in the mass of the ice. Knowing this, Dr. Holst thought it more fruitful to study the ice near its borders than to undertake time-wasting excursions into the interior.

The inland ice expands in a continuous sheet from the mountains of the coast-lying land eastward beyond the horizon, only interrupted by the "nunataks" and the moraines. The former occur very sparingly, only the high peaks of the underlying mountains rising

¹ A. E. Törnebohm: Mikroskopisk undersökning af några bergartsprof från Grönland insamlade af Dr. N. O. Holst. Geol. Fören. Förh. Bd. 6, p. 692.

above the ice. Of the moraines may be especially mentioned the morain-osar, deposited on the ice parallel to its border, and in undulating or even horseshoe-curved lines, following at some distance the headlands jutting into the ice-sheet. These moraines Dr. Holst proposes to call *border-moraines* ("rand-moräner").

The ice within a hundred feet from its borders invariably presents a slope toward the border, though generally not so steep as to render the ascent at all difficult. Farther in the slope is much less marked, though there appears to exist a general rising toward the east, whilst the surface everywhere presents vast undulations.

The border of the ice appeared to have retreated quite recently in many places; in others it had evidently advanced. This seems to be the necessary effect of the varying amount of precipitation of snow or rain over the glacier-basin, causing the glacier itself to vary in volume. The snow fallen during the winter seems to remain much longer on the inland ice than on the land. Thus, at Atarngup, above the Tassiussak-fjord, on the 25th of June the inland ice was covered with snow. At the Fredrikshaab glacier, on the 4th of July, the snow had melted near land and around the "nunataks," but remained over a great part of the ice-sheet, although numerous bare spots were visible. Still later in the season—by the middle of September—Dr. Holst made an excursion over the inland ice to the north of the Kipissako glacier. All the snow from the last winter had disappeared, but some new snow, blended with rain, had fallen and frozen to a thin crust over the ice.

On the surface the inland ice either presented the appearance of a compact mass of coarse crystalline texture, reminding of the grain of common rock-candy, or else it is honeycombed by the solar heat and shows intersecting systems of parallel plates, apparently the remnants of large ice-crystals, often several inches long, which have wasted away, only leaving the frame, as it were, on which they were built. These plates or tablets are highly mirroring, reflecting the solar rays in all directions, depending on the position of each individual crystal. The ice in the wild, mountainous regions of Southern Greenland is, as a matter of course, very much broken up by crevasses. Wherever the ice pushes forward and downward over an escarpment of the underlying ledge these crevasses, with great regularity, cross the direction or course of the glacier. Of most frequent occurrence, however, are the cracks which run at right angles to the borders of the inland ice.

Although the ice in the said mountainous district is everywhere crevasse-torn, it is not necessarily so in other localities. Where the underlying ground is level or only gently rolling, the moving ice is, no doubt, entirely free from cracks.

The local direction of motion must, of course, to a great extent conform to topographical conditions. Thus, in deep valleys glacial striæ may be found to run in all possible directions, always following the course of the valley. In order to find the general direction of the motion of the inland ice, one must study the striæ on the high plateaus. My observations in such localities indicate a direction from northeast or east-northeast.

The vastly broken aspect of a Greenland landscape cannot be explained as solely a product of the erosive force of moving glaciers. It is true that the material produced by this erosion is only to a small extent left on the land—where the soil is, indeed, very thin—whilst by far the greater part is deposited as silt in the sea. But if we suppose this silt to spread over the bottom of the sea for some miles from the coast and to have the thickness of several rods, still this cannot approximately account for the enormous excavations of the land. These must date farther back than the glacial period. The glaciers may, however, have plowed up and scooped out the loose sediments from earlier ages in the vast valleys.

On the inland ice occur *moraines* and *kryokonite* (glacial dust), besides patches of *vegetable matter*. The moraines are limited to the borders of the inland ice around the nunataks as well as along the coast-line. The kryokonite mostly accumulates between the moraines thus near to land, but is not altogether absent even from the high interior tracts of the ice-sheet. Vegetable matter occurs but sparingly on the ice. West of Kangarssuk, half a mile from land, were noticed some leaves of grasses, *Betula*, etc. They were not scattered, but heaped up in a pile—which seems to indicate that not wind, but water, had transported them to that position.

C. The *kryokonite* is extensively distributed over by far the greatest part of the inland ice, as well as over most of the local glaciers, though it may occasionally be hidden under snow or ice formed by the freezing of the thaw-water.¹ It varies, however,

¹ = Swedish smältvatten. The word, although not found in Webster, may serve to express the water formed at the surface of the ice by thawing.

considerably in quantity. In many places, especially far inland, the kryokonite spreads only as a light shade over the ice, whilst near to land it exists in far greater abundance. At Fredrikshaab's ice-blink the border-ice was dirty from immixture of kryokonite and separated from the higher-located, cleaner ice by a sharply-defined line parallel to the foot of the inland ice, this line having an elevation of six hundred feet over the foot of the ice.

The kryokonite has a dirty gray color, and upon superficial inspection appears like clay; but, on closer examination, it will be found to consist of very fine sand. Quite often it is formed in little balls as big as beans, which readily absorb heat from the sun, causing the underlying ice to melt, so as to produce the so-called "organ-pits." It may occasionally be washed down with the thaw-water from the higher places and then accumulate in patches. On the Arsuk glacier some such patches, about one square foot each in extent, were covered with kryokonite to a depth of three inches. It is not always easy to tell the difference between moraine-sand and kryokonite on the ice-rivers, where the moraine matter exists in every grade of fineness—from coarse gravel and sand to nearly impalpable dust, like the kryokonite. On the higher parts of the inland ice, where no moraines are found, this difference does not exist.

The following table shows the chemical composition of the kryokonite. No. 1 was a sample taken by Baron Nordenskiöld on lat. 68° 20' N. Nos. 2-6 were taken by Dr. Holst. For comparison is added an analysis (A) of gneiss from Ostergothland, according to Dr. H. Santesson.

	1	2	3	4	5	6	A
Silicic acid.....	62.25	62.93	62.74	56.30	60.67	60.55	63.72
Titanic " .....	.....	0.37	.....	.....	.....	.....	.....
Alumina	14.93	12.24	14.18 (P ¹)	16.45	15.63	14.97	15.74
Peroxide of iron...	0.74	6.43	.....	.....	.....	.....	2.74
Protoxide " ...	4.64	.....	3.90	4.10	6.35	6.28	4.31
Manganous oxide	0.07	0.32	0.92	0.54	1.10	0.14	1.29
Nickelous " .....	.....	None	.....	.....	.....	.....	.....
Cobaltous " .....	.....	None	.....	.....	.....	.....	.....
Talc	3.00	.....	3.01	2.44	2.37	2.54	1.40
Lime	5.09	5.61	3.02	3.62	3.70	3.73	3.56
Soda	4.01	7.75	3.47	4.94	3.79	3.70	1.64
Potash	2.02	2.22	1.26	2.52	2.52	2.99	3.72
Phosphoric acid...	0.11	None	.....	.....	.....	.....	.....
Chlorine	0.06	.....	.....	.....	.....	.....	.....
Water.....	3.20 ¹	2.23	4.25	9.69	4.78	4.89	1.00
	100.12	100.10	.....	100.60	100.91	99.79	99.28

¹ Including hygroscopic water, 0.34.

In his "Account of an Expedition to Greenland, 1870," Norden-skiöld gives the above analysis No. 1, and, on the strength of it, pronounces the kryokonite "a trachytic sand of a composition (*e. g.*, the amount of sodium) which indicates that it does not derive its origin from the granite-bearing region of Greenland." He leaves the question open whether it is derived from the basalt region or from volcanoes supposed to exist in the interior of Greenland, or whether it is of meteoric nature. He regards it as a distinct species, for which he gives the chemical formula, and even states that its crystal form is probably monoclinic. By comparison with the analysis (A) of a Swedish gneiss, it becomes evident that his conclusions are invalid. Evidently the analyses point to the primitive rocks of Greenland as the origin of the kryokonite. Even the high percentage of soda has no great bearing on this question, as many Swedish gneisses¹ have a higher percentage of soda than the above No. 1.

Dr. Holst devoted special attention to the kryokonite in Greenland, and collected samples of it from ten different localities between lat. 61° N. and 65° 25' N.²; and he came to the conclusion that this substance is nothing but the finest till separated by repeated washing.

The thaw-water from the surface of the inland ice penetrates through cracks into confluent gutters down in the moraines in the deeper parts of the ice, and, washing out the finest till, it continues its course until it connects with similar gutters, carrying water from higher-located tracts. Hydrostatic pressure will then force back water toward the lower tract. The suspended moraine matter will follow; but as soon as equilibrium is restored it will settle in pores and cracks of the ice. The water may but rarely reach the surface immediately. But when the moving glacier encounters an elevation of the ground, the lower portions of the glacier will be pressed up to a higher level. As the ice is melting away from the surface the enclosed matter will gradually appear at the top. Upon reaching the borders of the inland ice it will be carried away by the glacier-rivers and deposited in the sea. These rivers in Greenland are

¹ According to Santesson's "Kemiska Bergarts analyser." Sveriges Geol. Undersökning.

² Nordenskiöld's samples were all taken from nearly the same locality, viz., about 68° N. lat.

very turbulent, and the kryokonite, therefore, mingles with the clays and sands, which are whirled down by them into the sea. But if such inland ice were advancing over a plain, and the kryokonite were washed out from it by quietly-running water, it would, no doubt, get an independent geological significance.

This theory presupposes the existence of kryokonite, not only on the surface of the inland ice, but also in its deeper parts. That this is the actual case is plainly visible near the borders of the ice.

Microscopical analyses of the kryokonite were made in 1881 by A. von Lasaulle, F. Zirkel, and E. Swedmark. All agree in the main: *The kryokonite contains nothing but the ordinary components of primitive rock.*

Professor Zirkel found Dr. Holst's samples to contain mainly the following minerals, viz., quartz, orthoclase, plagioclase, greenish and brownish mica,—which he supposes to be a magnesia mica,—and colorless potassium mica (this last mineral occurring but rarely). He also found some hornblende, garnet, magnetite, and (doubtfully) traces of titanite and epidote. In all cases the principal constituents were quartz, magnesia mica, and feldspar. The thinnest scales of mica pierce through the feldspar fragments, just as they do in the gneisses. Metallic iron was never identified in the samples. Professor Zirkel calls particular attention to the total absence of any augite, olivin, or glass. Both chemical and microscopical analyses agreeing, it may be regarded as a settled fact that the kryokonite has the same origin as the moraines. It is far more difficult to solve the question regarding the geological significance of the kryokonite. During his visit to Greenland, Dr. Holst was inclined to suppose that it nowhere forms independent deposits, but always occurs commingled with the clays and fine sands of the till, the kryokonite, as to its grain, being intermediate between the two. It is sand, but considerably less palpable than any ordinary kind of sand. However, since he had opportunity of studying the *loess* in Saxony, he came to the conclusion that *the loess is nothing but kryokonite.*

Considering the loess (kryokonite) as a product of repeated washing processes, in the manner above stated, it is easy to conceive why it has reached such remarkable extent and purity.

The State Geologist, E. Swedmark, having examined microscopically samples of loess collected at Ebendorff, near Magdeburg, and

at Dresden, found them to consist of fine rock-powder, in which he identified fragments of *quartz* as the most prominent constituent, besides feldspar, plagioclase, green hornblende in considerable quantity, mica (mostly biotite), a trifling amount of magnetite, numerous dendritic or, sometimes, kidney-shaped grains of an ochre-like mineral, and fine particles of *clay* and *limestone*. Such a composition (says he) indicates certainly that this loess leads its origin substantially from disintegrated primitive rocks (gneiss or granite) and diorite.

The dust on the inland ice of Greenland offers a suitable soil for quite a number of small algæ. Professor V. B. Wittrock examined some of the samples of kryokonite, and the results of his investigations are embodied in his paper, "Om snöns och isens flora."¹

(To be concluded.)

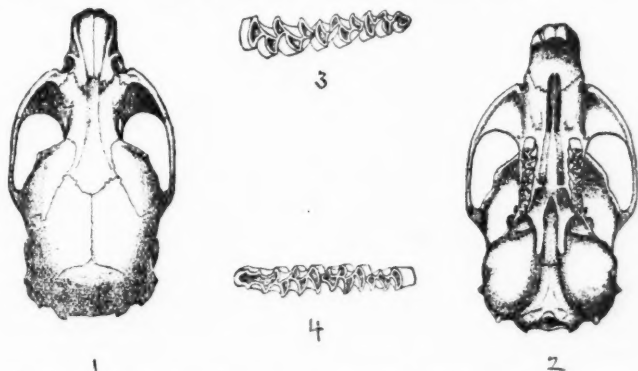
DESCRIPTION OF A NEW PRAIRIE MEADOW MOUSE (*ARVICOLA AUSTERUS MINOR*) FROM DAKOTA AND MINNESOTA.

BY DR. C. HART MERRIAM.

A LARGE series of meadow mice of the genus *Arvicola*, collected during the past two years in Minnesota and eastern Dakota, comprises but two species, which, in the field notes of the collector, Mr. Vernon Bailey, are designated respectively as "upland" and "lowland" meadow mice. The "upland" form is never found on the marshes, but the "lowland," which is most abundant in wet meadow lands and in the neighborhood of streams, sometimes occurs on the dry prairies in company with the other. Externally, some of these mice resemble one another so closely that sharp discrimination is necessary for their separation. A glance at their teeth, however, shows that they belong to different sub-genera. The "lowland" species has two external closed triangles on its last upper molar, a postero-internal loop or "spur" on its middle upper

¹ A. E. Nordenskiöld: Studier och forskningar, föranledda af mina resor i höga Norden. Stockholm, 1883, pages 63-124.

molar, and three internal and at least two external closed triangles on its front lower molar—and consequently is a *Myonomes*, closely related to our common eastern meadow mouse, *Arvicola* (*Myonomes*) *riparius*. The “upland” species has but one external closed triangle on the back upper molar, lacks the “spur” of the preceding tooth, and has but two internal and one external closed triangles on the front lower molar—in other words is a *Pedomys*, nearly related to the prairie meadow mouse of the Mississippi Valley, *Arvicola* (*Pedomys*) *austerus*. For purposes of critical comparison, therefore, the remaining sub-genera of *Arvicola* may be summarily dismissed. The sub-genus *Pedomys*, according to Coues, the latest monographer of the group, contains but the single species, *austerus*. He also placed in this sub-genus, and in fact as only sub-specifically separable from *austerus*, a very different mouse (namely, his *Arvicola austerus curtatus*) which is not a *Pedomys* at all, but, as I have recently shown, belongs to the sub-genus *Chilotus*. This leaves *austerus* as the only species with which Mr. Bailey’s “upland” mouse may be compared. The principal difference is in size, the new form being a miniature of *austerus*. The case has a parallel among birds, in the hairy and downy woodpeckers (*Picus villosus* and *P. pubescens*),



2224-4 male *Arvicola* (*Pedomys*) *minor* Merriam. 1 and 2, skull from about and below $\times 2$; 3, upper molar series, $\times 3$; 4, lower molar series, $\times 5$.

except that in the case of the mice the ranges of the two are not known to overlap. In my series of considerably more than a hundred specimens of *austerus* proper I do not find a single adult indi-

vidual as small as the largest of about thirty specimens of the northern animal. The average difference in length, without the tail, is nearly 25 mm. (about an inch). In typical *austerus*, the hind foot averages 19 to 20 mm., while in the new form it averages but 16 to 17 mm. In adult skulls of *austerus* the average basilar-length falls between 24 and 25 mm.; in the northern form it falls between 20 and 21 mm. In reference to its diminutive size, I have named the northern mouse

ARVICOLA AUSTERUS MINOR, sub-sp. nov.

Northern Prairie Meadow Mouse.

Type $\frac{3927}{4466}$, male, Merriam Collection. From Bottineau, Turtle Mt., Dakota, August 27, 1887.

Description of Type.—Similar to *Arvicola austerus*, but much smaller; length from end of nose to tip of tail vertebrae (measured in the flesh), 133 mm.; tail vertebrae, 36 mm.; hind foot, 16.5 mm.; ears rather prominent, slightly overtopping the fur.

Color.—Upper parts uniform grizzled gray; under parts whitish, washed with pale cinnamon. Viewed from behind, looking away from the light, the entire head, back and sides appear to be finely and closely lined with silvery. The fur of the belly is plumbeous basally and nearly white apically. There is no sharp line of demarkation between the color of the sides and that of the belly. Tail bicolor, the light color of the under surface reaching well up on the sides.

Description of other Specimens.—The type, which is from Turtle Mt., Dakota, is very closely matched by specimens from several places in the Red River Valley (particularly from Travare, Dakota, and Ortonville, Minnesota); and by a few of the Elk River specimens. A male from Elk River (No. $\frac{3991}{3601}$), collected June 2, 1886, is almost a duplicate of the type, except that the belly is darker—it is more sparsely haired, and the plumbeous basal portion of the fur shows through. Other specimens from Elk River have the upper parts strongly suffused with brown, and the belly strongly washed with cinnamon.

In others there is as much whitish on the belly as in the type; while in others still the under parts are of the "muddy rust color" so often seen in true *austerus*. This is pronounced in No. $\frac{4184}{4723}$,

male, from Elk River. The variations in color of under parts do not seem to depend on age, sex, or season, though of course the fur is everywhere longer and more dense in winter than in summer, as is the case in all northern *Arvicolæ*.

General Remarks.—*Arvicola minor* is so different from all American *Arvicolæ* except *austerus* that comparison with others is unnecessary. Lest, however, there should be any question as to its distinctness from "*A. cinnamomea*" of Baird, which is said to have come from Pembina, I have measured the skull of the type (No. 591, male, U. S. National Museum—the skin has been lost), and find it to be as large as that of *austerus* proper. And Baird's measurements of the animal show that it was larger even than average *austerus*. The dental peculiarity pointed out by Baird as one of the distinctive characters of the supposed species, namely, the fact that the angular depressions in the crowns of the back upper molars communicate across the teeth, forming transverse loops instead of lateral triangles, I incline to agree with Coues in considering abnormal.

ON ARCTIC CHARACTERS OF THE SURFACE
FAUNA OF THE BAY OF FUNDY, AND THE
CONNECTION WITH A THEORY OF
THE DISTRIBUTION OF FLOAT-
ING MARINE LIFE.

BY J. WALTER FEWKES.

SEVERAL naturalists have shown a similarity between the fauna of the Bay of Fundy and that of the waters of Labrador and Greenland. This comparison is of great interest to students of New England marine zoology.

As the evidence thus far adduced is mainly drawn from studies of littoral animals, it has seemed in place to test the theory by a consideration of oceanic genera. It would be pre-eminently fitting to consider floating marine life with this thought in mind, and as the young of a large number of marine genera are free-swimming,

it would be well to include them with true oceanic genera in this connection. I undertake this comparison with more enthusiasm, as it has been my good fortune to examine and publish notices of nomadic animals which have been collected in high latitudes by Lieutenant Greely, and since it has been possible for me to study the marine life of Grand Menan and the islands off the coast of New Brunswick.¹

A study of the surface life of the Bay of Fundy reveals interesting facts in the theory of the Arctic relationship of the life of these regions.

Nomadic animals which live in the high seas, generally upon the surface of the ocean, are known as pelagic animals, and constitute what is called the pelagic fauna. While this fauna is pre-eminently the fauna of the ocean and is found best marked at a great distance from the land, it often happens that winds and currents sweep its members into our bays and harbors, and we in this way become familiar with it. Like all large bays with open access to the ocean, the Bay of Fundy has a pelagic fauna. It is, in fact, the same or nearly the same as the pelagic fauna of the coast of Greenland.

Animals which are strictly pelagic are never limited to the coast, to the littoral fauna, or to the sea bottom. They never become attached, but crawl about, or rest upon the sea floor. A large number of marine animals have young which resemble pelagic organisms in these nomadic habits. They also wander about and are carried hither and thither by ocean currents independent during their youth of the coast or the sea bottom. As they reach maturity, however, they sink to the sea floor, and there remain, either attached or limited in their movements to a small area. These young or larvæ, as they are called, may also be included in the pelagic fauna as long as they preserve this free-swimming feature. This larval and adult pelagic fauna differs in different regions of the ocean, and that of the Bay of Fundy differs in a marked manner from that of the bays of southern New England.

A study of the pelagic fauna of the Bay of Fundy shows that it has a boreal character. While it is in many respects like that of

¹ I have already elsewhere (*Bull. Mus. Comp. Zool.*, vol. xiii., No. 6) considered the boreal relationships of the medusan fauna of the Bay of Fundy.

Massachusetts Bay, it is in marked contrast with that of the bays south of Cape Cod. We may, in fact, say that the fauna of the Bay of Fundy is more closely allied to that of the coasts of Greenland, as far as its pelagic life is concerned, than it is to that of Narragansett or Buzzards Bay. The reason for this diversity in the inhabitants of bodies of water so near together, and the resemblances of faunæ of localities so far apart, may easily be found in the direction and character¹ of oceanic currents to which the distribution of marine life is almost wholly due. Moreover, the surface life is in a measure dependent on the amount of water brought to the coast by the tides. The greater the volume of water which sweeps into the bay, the larger the number of animals which it brings with it, if other conditions remain constant. The great tides of the Bay of Fundy are admirable for the purpose, and they bring to the shores of New Brunswick a wealth of surface life seldom equalled and never excelled elsewhere on the coast.

There is a strict line of demarcation between the surface fauna found south of Cape Cod and that immediately north of the same headland. It would seem the most natural thing in the world that an animal which passes its life floating or swimming on the surface waters of the ocean should live equally well in Narragansett Bay or the Bay of Fundy. That is, however, not the fact, for while stragglers from the true Arctic faunæ of the waters of New Brunswick may sometimes be found at Newport, there is as marked a difference in the facies of the faunæ of the two regions as between those of the two sides of the Isthmus of Panama. Why is there this difference?

The answer is found in those limitations in the distribution of animals brought about by the differences in the temperature of the sea. Everyone who has tried the ocean bathing in these two localities knows how much warmer the surface water south of Cape Cod is than that of Grand Menan, and this difference of temperature means life or death to the delicate creatures which live in it. The animals south of Cape Cod are those of warmer waters, and some of them have their home in the Gulf Stream, while those in the Bay of Fundy are pre-eminently of polar origin, and can endure with impunity a fall in temperature which would kill the

¹ The boreal life of the Bay of Fundy is thought to be due to the Labrador current.

inhabitants of the Gulf of Mexico. As the study of animals which are not nomadic teaches that those of the Bay of Fundy are most closely allied to the inhabitants of the colder waters of the Arctic,¹ so it is with the surface life. Both tell one and the same story, that the assemblage of life in the sea which constitutes the fauna of the Bay of Fundy is Arctic in its affinities. To demonstrate the Arctic character of the free-swimming life of the Bay of Fundy would seem to necessitate a minute comparison of faunal lists from the two localities. It is not wholly necessary for our present purposes, however, to make such an extensive comparison. Some of the more striking instances of floating boreal life will suffice.

Of all floating animals the jelly fishes are well suited for this study. Among the Medusæ we have marine animals, as well known as any, from which to test our theory. The following may be mentioned as some of the Medusæ of the Bay of Fundy which are markedly Arctic. The large and beautiful *Cyanea arctica*, one of the most stately forms of discophorous jelly fishes, is pre-eminently an Arctic genus. *Cullinema*, first described by Professor Verrill, another large Medusa of the same group, and has never been seen south of Cape Cod. Among Hydromedusæ the beautiful *Turris episcopalis* is boreal in its distribution, and rarely gets south of the coast of Maine. *Staurophora* and *Halopsis* are northern genera. The beautiful "sea necklace," *Nanomia cara*, one of the most exquisite genera of marine animals, has been seen in the icy waters of Robeson's Channel by Arctic navigators. It is rarely seen south of Cape Cod, in Narragansett Bay, but at Grand Menan hundreds of specimens, some of which were four feet in length, were taken from the landing places, and at other points on the shore.

If we, in fact, take the faunal lists of the Medusæ of the Bay of Fundy and compare them with those from Greenland and neighboring waters, we find, as far as our knowledge goes, a strong resemblance between the medusan life in the two regions. Of course there are genera occurring in the waters of Greenland which are not to be found in the Bay of Fundy, and *vice versa*, but that does not change a belief in a general statement that the marine animals of the two localities resemble each other in facies. If we

¹ The surface animals of the Bay of Fundy, although Arctic, are not supposed to be of the extreme polar types. For obvious reasons little is known of the facies of polar marine life.

should carry our comparisons of the surface life of the two localities among other groups, we should find as marked a similarity there as among jelly fishes. One or two examples may suffice for illustration.

There is no pelagic mollusc which is more truly boreal than the well-known *Clione borealis*.¹ This pteropod rarely ventures into Narragansett Bay, is more common as we go north, and was at one time observed in great abundance in the Bay of Fundy. In the North Atlantic and on the shores of Greenland it is found at times in countless hosts.

Among the pelagic annelides, one of the most common at Grand Menan is a species of *Sagitta*, which bears a strong resemblance to a *Sagitta* found in Lady Franklin Bay by Lieutenant Greely. This Arctic *Sagitta* is markedly different from the *Sagitta* of Narragansett Bay.

The species of Appendicularia found in the Bay of Fundy is different from that of Newport, and appears to be the same as that recorded by Murdoch from Point Barrow. This pelagic ascidian, as is well known, is found in some places enclosed in a gelatinous envelop called the "*haus*," which serves as its protection, or for other purposes. Although I have repeatedly taken Appendicularia in Narragansett Bay, I have never found the "*haus*" in those waters. From Murdoch's description of the Arctic Appendicularia and from its size, I am inclined to think that the Bay of Fundy Appendicularia² will also be found with houses. The mere fact alone that the Arctic Appendicularia has the house, so-called, is not characteristic, for animals of this or allied genera in warmer waters have the same structures.

The resemblances between these two marine faunæ suggest interesting general questions of distribution. Students of the geographical distribution of terrestrial animals easily recognize the facies of organic life from different continents. A collection of the land animals of Australia has an altogether different appearance from one from Europe, while those from South America are different from those of North America. While the characters which impart

¹ I have taken many specimens of the larva at Newport.

² It is undoubtedly true that the Bay of Fundy Appendicularia is a different species or even genus from that of Narragansett Bay. It closely resembles the genus *Oikopleura*.

this difference are hard to define, they exist and are recognizable by a specialist. In the Museum of Comparative Zoology at Cambridge this difference is shown by faunal assemblages of life from different regions of the globe, each arranged in different rooms, known as the North American, European, African, etc. The idea is a grand one, and to a student of physical geography of the greatest importance.

As in the study of land animals there is a different facies to the assemblages of life from different quarters of the globe, so in the ocean there is a different facies in collections of animals from different regions of the sea. Place side by side a number of Arctic species of shells and those of the same genera from the tropics. If the shells be representative, the conchologist need not hesitate long as to their homes. The dull, cold, little variegated molluscs of the Arctic contrast markedly with the brilliant, gaudy shells of the warmer zones. Passing to the inhabitants of the ocean, the deep-sea animals have an altogether different facies from the surface animals. The characteristic facies of great regions of the ocean are as noticeably different as those which naturalists have long recognized among terrestrial animals. It is not in place here to point out the different regions into which the oceanic faunæ may be divided, but it would be interesting in considering the causes of the boreal character of the pelagic life of the Bay of Fundy, as they involve a general consideration of the laws which have led to the diversity of these faunæ. I consider the temperature of the water as a most important influence in causing the diversity of life in the ocean. Variation in temperature is probably more important than pressure in the bathymetrical distribution of deep-sea life. The difference in temperature of the surface of the ocean is one of the most important factors in determining the character of pelagic organisms. As we have a variety in surface temperatures, we have a diversity in the surface fauna. We have, it is held by some, a repetition of Humboldt's law of the modification of plants in altitude, and the correspondence of latitude with altitude, in a change in character of animals by depth resulting from several conditions, among which may be mentioned pressure and temperature. Whenever the temperature of the deep-sea becomes a surface temperature, as in the Arctic Ocean, then, it is argued, we may look for allies of deep-sea animals.

The two great tendencies at work in the modification, as in the geographical distribution, of pelagic animals, are cold currents of water bringing them into lower and warm currents transporting them into higher latitudes.¹ The physical result in both instances is a change in the temperature of the water and other conditions in which they live. Where the currents generally set from the south to the north, as on the eastern coasts of the Northern Hemisphere, we may expect a relationship to the tropics in higher latitudes than where the currents are from the pole. The former currents carry the warm belt into higher, while the latter restrict it to the lower latitudes. It is known that the distribution of coral reefs on the western and eastern coasts of the continents has a direct relationship to the direction of the ocean currents, and that where the current is from the equator to higher latitudes (Eastern coasts) coral reefs extend farther from the equator than where the general direction of the oceanic rivers is from colder to warmer latitudes.² This can readily be seen by consulting a map of the earth's surface where all the great coral reefs are on the eastern side of the continents, and where also all the great oceanic currents are setting from the equator towards the poles.

This law in the distribution of corals, pointed out by Dana, is believed to hold also in the case of other animals, which, unlike corals in their mode of life, are not fixed, and have left no hard secretions to denote their former or present existence.

It will be seen by a consultation of Krümmel's maps of the distribution of surface temperatures in the Atlantic, and by a reference to the chart of the surface temperatures published in *Science* for December, 1887, that the Bay of Fundy does not lie in the same isothermal zone as do the waters of the coast of Greenland. Perhaps these zones were only intended as approximations, and the temperature of the water of the Bay of Fundy may not be higher than of that of the coast of Newfoundland. In the chart referred to, the Bay of Fundy is near the southern limit of the zone of low surface temperature, and the high tides may account for the large percentage of boreal surface animals in its waters.

¹ The pelagic life washed to the coast of England will probably be found to differ from that of Labrador under the same latitude.

² Possibly due also to the food of the coral, minute floating life, which is furnished in greater abundance on account of the currents.

The student of the geographical distribution of pelagic life will, I believe, find a correlation between the facies of this fauna and the zones of equal temperatures of the sea. An improvement in the projection of these zones on the maps of oceans will lead to a corresponding advance in our knowledge of the distribution of marine life characteristic of the surface of the sea. If we accept the proposition that the pelagic fauna of the Bay of Fundy is Arctic in its facies, it becomes an interesting thing to study carefully this fauna in its relation to animals found in deep-sea.¹ Is there a closer affinity between animals found on the surface of the ocean, where the water has an Arctic temperature, and those of the deep water where the temperature is the same, than between those of the surface of the ocean in the tropics and deep water, where there is a marked difference in temperature? Although marine zoology has never been a primary object of polar exploration, it is probably true that most interesting results are to be looked for if the attention of Arctic explorers is turned to the importance of this study. Let me call to mind one interesting aspect of the study of marine animals from polar regions. Now that the character of the deep-sea fauna may be said to be known, as far as its general facies is concerned, it may be well to ask whether there are any places on the globe where conditions found in deep water are repeated in shallow seas, and where there is a similitude in the environment under which life exists.

There are two conditions under which deep-sea life is placed which may be considered. The first of these is pressure, a condition which we can normally expect to find only in the sea at great depths; the second is a low temperature of the water which exists in certain oceans at the surface.² A third condition, viz., the amount of light, is in a way connected with the second. In my consideration of the subject it is not discussed.

¹The explanation advanced by physical geographers that cold waters near land are sometimes due to a replacement of surface waters by those from great depths may explain many peculiarities in the distribution of life.

²Murdoch's record of pelagic animals taken from the Arctic Ocean when the temperature was 29.1° F., is among the most valuable which have been made on the character of pelagic life in water of this low surface temperature. If they are not the first observations on this subject, they are certainly the most complete.

In many invertebrate animals the difference in pressure at 1000 fathoms and at one fathom is endured with impunity by the same species. Difference in pressure under which a deep-sea animal is placed is not believed to be the influence which is most important in the determination of the limitation of deep-sea fauna to certain depths.

Invertebrate animals, however, which can endure equally well enormous pressures or live near the surface without harm, are delicately susceptible to a change of temperature of a few degrees. Temperature has drawn even in littoral zones invisible limits or lines of demarcation, which are partially known to naturalists. The laws of the diminution in heat with the depth has also been shown. It is known that the bottom temperatures of deep-seas are surface temperatures in some parts of the globe. If temperature, is an important condition of the environment of deep-sea animals, it is significant to discover what the character of the marine life is in latitudes where the temperature is that of the deep sea and where it is constant.

The polar oceans show on the surface of the water the low temperatures of the deep seas. Those temperatures, to find which in tropical oceans the plummet has to go many fathoms below the surface here come to the surface, and are its ordinary temperature

It is interesting to discover whether in places widely separated in latitude, but where the temperature of the sea is the same and constant, we find any uniformity in the ocean fauna. It must be recognized that we have in the great body of water which composes the ocean a mass of liquid, the temperature of which is modified by local currents, vicinity to the land, and other conditions. As a general law, to which there are some exceptions, it may be said that the temperature of the sea decreases as we sink below its surface. Of all places in the ocean, where the limits of variations in temperature are small, none equals the deep water. A maximum variation in the tropics may be found on the surface and in the neighborhood of the coast line. The minimum is far below the surface in the deep water.

It may readily be imagined that, if there were no distribution of heat in the ocean by currents as we go north or south from the equator, we should find the isothermobatric lines, or lines

of equal deep-sea temperature, gradually approaching the surface of the sea until we come to the icy waters of the pole. Here we should find a law of the distribution of heat similar to that which holds on land, where there is a constant relationship between the altitude above the level of the sea and the latitude as far as the diminution in temperature is concerned, unless modified by local conditions. As we ascend the tropical mountain the heat, as a general thing, diminishes; the same is true as we go below the ocean. As we increase our latitude in either case, the temperature follows a common law in its change, approaching *pari passu* the level of the sea.

It was long ago recognized that the distribution of plant life on a tropical mountain is correlated with the change in temperature, and that in ascending a tropical mountain-side we pass through the three climatic zones. The author does not know how far this theory is now accepted by botanists, but it is interesting to see whether a similar law holds in the ocean where there is a like change in temperature. We know that there is a peculiar fauna of those animals which habitually live on the bottom in the deep sea. We know there is an æquatorial marine life which is confined to the surface of the ocean, represented by *Physalia*, *Vevela*, and others. Associated with the latter are other genera, as *Atolla*, which sometimes go down to 1800 fathoms below the surface. Are there any medusæ at 1800 fathoms which rise to the surface without destruction? I think there are, although our facts are not decisive enough to prove it.¹ I also believe that there are nomadic deep-sea animals which in the tropics cannot rise through the stratum of warm water above them without harm, but it by no means follows that where these low temperatures of the deep seas become surface temperatures they may not come to the surface of the sea.

It seems probable that the cold areas of deep seas have preserved uniformity of environment for a much longer period of time than warmer areas of the surface. The water of the ocean in different strata is, of course, varying its temperature, but there are certain positions where an almost uniform temperature has been kept up for long periods of time. The uniformity of conditions in

¹ Since this was written a large number of observations by Chun have shown the truth of this belief.

the cold polar seas, as far as temperature of the water goes, is greater than under the equator at the surface. Consider the waters of the polar ocean covered by a palæocrystal ice, and those unprotected under the burning tropical sun. In the one there is certainly a minimum of variation in temperature, in the other a maximum, as far as the water is concerned. If environment, if uniformity of conditions, has anything to do with variation in forms of life or with the preservation of ancestral features through long periods of time, should it not appear in the animals which live under these conditions?

There is a certain parallelism in the animals of cold and warm oceans and those of deep seas and littoral zones. It is, of course, impossible to link together what we know of deep-sea life with that of the polar region with any hope of a satisfactory answer as long as our knowledge of either is incomplete. Fortunately the character of deep-sea life in late years has been investigated. As far as this problem goes, the least satisfactory part is that which pertains to the *nomadic* deep-sea genera. With regard to the marine life of the polar regions, where the deep-sea temperatures become surface temperatures, much remains to be done. We know the littoral marine Invertebrata of the polar sea better than those of many bays contiguous to our own country, but the subject of the marine surface fauna is yet to be more fully investigated. If polar exploration is to be continued, as there is no doubt that it will be, a more complete study of the marine life would be an important object of such exploration, and would be of value to our knowledge of the geographical distribution of marine animals. It would be interesting to take up again the somewhat threadbare discussion of a relationship between the Arctic and deep-sea faunæ. It might verify a prediction that it is possible to recognize ancestral forms among those which people the icy waters of the polar seas. The theory of the Arctic character of deep-sea faunæ is by no means a new one, and as long as the zone of deep water from 100 to 300 fathoms was studied there seemed to be a marked likeness between these two faunæ. When, however, the variegated fauna of the abysses of the ocean came to be studied, it became more difficult to found resemblances between deep-sea animals and those of the poles. Our comparison of deep-sea floating life with the polar introduces a new phase in the discussion,

as the animals which we are considering are not attached, but are nomadic in nature. There is nothing to prevent a comparison between the nomadic life of deep water and that of the Arctic, even if the facies of the abyssal zone is different from that of any oceanic fauna of the globe. While the difficulties in the investigation of the animals of the polar regions are such that much remains yet unknown in relation to the surface life of these latitudes, the similarity of that of the Bay of Fundy to it, if such a likeness really exists, renders this study comparatively easy. It becomes imperative, then, to know accurately the facies of this fauna if one would use this knowledge in comparisons with deep-sea faunæ.

CEREBROLOGY AND THE POSSIBLE SOMETHING IN PHRENOLOGY.

BY S. V. CLEVINGER, M.D.

TEN years ago, in the *American Journal of Nervous and Mental Disease*, I reviewed the history of brain studies, from Erasistratus to Ferrier, and described the convolutions and fissures with their equivalent names as used by English, German, French and Italian investigators. Microscopic details had at that time added immensely to our knowledge of the structure of this important organ, but since then pathological and physiological science has corrected many of the errors prevalent and improved our understanding of the localization of function.

When it was established that arm, leg, tongue, ear and eye centres were distributed about the brain cortex, beneath alleged bumps of conjugality, appetite for music, theology and onions, phrenology was discouraged except among its more ignorant devotees. At the conclusion of a popular lecture on the anatomy and physiology of the brain I was assailed by an itinerant phrenologist who did not relish his dollar-a-head prospects being jeopardized by the spread of my heresies. He offered to stake money on the infallibility of his "science" in a public demonstration, and when told that phrenology had been written up in a form available for criticism and

found to be defective, he warmed to the conclusion that he could lick any one who opposed phrenology with such "ipsy dixys."

Gall and Spurzheim are always cited by phrenologists as the founders of their system. While this is true, and it is also undoubted that they were in advance of the early part of this century in brain anatomy and philosophical guess work of brain functions, it is forgotten that but few anatomists of note have sustained the theories that have been piled upon the fairly well done work of a time when brain study was infantile. The ignorance of those who practice phrenology as an art, their illogicality, impudence and rapacity for fees, the fact that phrenology stands isolated from all the sciences, having nothing to do with physiology, chemistry, microscopy or pathology, as cerebrology has; its frequent defiance of exact knowledge which negatives the pretensions of bumpology, —all relegate phrenological claims to an equality with those of spiritualism, Christian science, jugglery and the multitude of penny-catching devices of an age of never-failing crops of knaves and fools. There is nothing like a good knowledge of physiology to destroy charlatanism and the superstition upon which it fattens.

But alchemy gave us some chemical facts, and astrology was mixed up with a few astronomical truths. Psychical research societies are trying to examine prestidigitation as one would study the mechanism of a watch through its key-hole, and it seems to me that patient study can be applied profitably to an examination of moribund old phrenology.

The tendency was extreme to locate pin-head points on the cranium that would reveal such things as whether one preferred coffee to tea; but, starting with the admission that there is a little truth in phrenology, in a general way, we are also confronted with the fact that, no matter how it is done, there has been some pretty shrewd guessing at character by even ignorant phrenologists. Their physiognomy studies are incomparably inferior to those of Darwin, or even those of the windy Lavater. Every one is an unconscious physiognomist without having analyzed expression; phrenologists make use of this common ability in estimating character. But this does not include their entire method, as they often hit off traits more happily than mere expression would enable them to do.

First of all let us glance at what is really known about heads

and their contents, and then see how much of phrenology can be adjusted thereto.

Prognathism and acuteness of Camper's angle are well-known indications of less intelligence. Apes also have less skull capacity with larger and more numerous ridges for muscle attachment.

The European has a characteristic medium (mesocephalic), rounder, oval or elliptical head, with no portion too prominent or flat, presenting more symmetry of contour, with oval face and full, expanded, elevated forehead. Want of symmetry, if marked, attends mental defect, but it has occurred in highly gifted men such as the French anatomist Bichat. No two heads are exactly alike any more than are two faces. The proportions existing between the front, middle and back parts of the head are of some value; departures from a width of eight and length of ten (mesocephalism), measured from one auricular aperture over the head to the other, and nose root over the head to the nucha, determine whether the skull shall be considered long, dolichocephalic, or broad, brachycephalic.

The front expanse is associated with a possible reasoning power, the back part with animality, but as this is necessary to force of character, a well-balanced head would be one that had a fair size of both parts. As the frontal bone is elevated the parietal must be raised to meet it. The artist Haydon, by cutting off this parietal raise, showed that the head was reduced from an intellectual to an animal appearance. Scaphocephalism, or a boat-shaped depression of the summit, occurs from defective parietal bone formation.

The Kalmucks incline to brachycephalism, while the negro is dolichocephalic, with prognathous jaw, large temporal and auricular muscles and low foreheads; the Esquimaux are tectocephalic (rafter-headed), with flat, pyramidal or lozenge-shaped faces, due to excessive zygoma projection, and narrow foreheads.

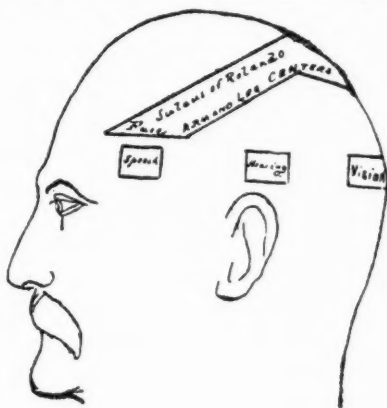
Carpenter notes that want, squalor and ignorance diminish the cranial and increase the facial size.

With increase of intelligence there is a larger brain mass in proportion to the muscular size, and also to the size of the spinal cord and peripheral nerves. I claim priority¹ in adopting the sulcus of

¹ Sulcus of Rolando and Intelligence. Written Feb., 1880. *Journal of Nervous and Mental Disease*, April, 1880.

Rolando as a means of estimating grades of intelligence in animals by the relative *masses* of brain parts it separated. Meynert¹ had, unknown to me, nearly simultaneously, stated that the angle at which the Rolandic departed from the Sylvian fissure was a measure, but in this he is in error, for that angle is *not* constant for species, while the relative proportions of fore and rear brain divided by the Rolandic sulcus maintain a just ratio to grades of intelligence, and the left sulcus summit should be farther back in the normal brain than the one upon the right side. I also claimed that the cerebellum was covered by the cerebrum in proportion as the frontal lobe developed and crowded the occipital portion backward. The forehead by this pressure is correspondingly expanded and lifted.

In the scale of higher intelligence the connecting commissures of the brain are more numerous, and the cortical gray matter is encroached upon by more cells and fibres. Convolutions are not necessarily more numerous, except where the cranium is relatively small and the soft brain tissue by rapid growth folds in to accommodate itself to the want of corresponding skull growth.



In accord with the results of earlier electrical experiments upon the bared brains of anthropoid apes, dogs and other animals, are the effects of disease limited to special parts of the brain of man,

¹ Archiv für Psychiatrie, vii.

more recently and thoroughly studied. We now know that there are centres in the brain of man for the speech faculty above the temple, and thence backward and upward to the upper back part of the head are arm and leg centres; auditory mental impressions being registered in the brain above the upper ear tip; a centre for visual function being in the occipital end of the cerebrum. The frontal brain is known to contribute to intellectual processes, for its injury degrades the character. This approximately sketches what has become positively known, and the illustration further assists the comprehension of these facts. The touch sense centres are distributed over the brain coincidentally, with motor centres for the same parts, *i.e.*, arm motor and sensory areas are in the same part of the brain.

Spaces intervening between the areas may readily be conceived to be filled with fibrils and cells that interrelate these and other functions complexly, the frontal portion compound complexly.

Sir Charles Bell remarked that "we ought to define the hand as belonging exclusively to man." Upon the increased dexterity in the use of fingers in the arts and sciences, which dexterity, in turn, develops brain centres, depends, largely, increased intelligence. Manipulation and vocal training enlarge the "symbolic field" of the brain (the speech, arm and leg centres before mentioned), situated along the sulcus of Rolando. Man is distinctively the symbolic animal, and whether these symbols are written, spoken or gesticulated, they serve purposes of intelligent intercourse, and upon this fact is based man's supremacy over other animals, and his higher faculties are superimposed thereupon.

When the portions of the brain allotted to control of body extremities are diseased, the dependent loss of function follows, but not necessarily involving mental loss; for example, if the injury is at the summit of the sulcus of Rolando, upon one side of the brain, the body is paralyzed upon the opposite side. The "blank spaces" between these centre areas afford debatable ground, for often injury in such parts has been followed by no discovered consequence. My opinion is that the effects have not been looked for in the proper direction; for, while destruction limited to these blank parts does not occasion loss of observable function (the arms, legs, speech may be unaffected), there will be found an attendant lowering of the

mentality in some or several directions, if thorough tests be made. What has been grouped under change of character should be sifted to ascertain what constitutes the change. If we grant, as we must, that all these function areas, ascertained to be such, are related, connected, by multitudes of strands and cells in the most complex manner over and across the blank spaces, then lesion of those spaces must interfere with the connections, the mental associations possible before cannot now be made. Occasionally "word deafness" or "word blindness" occurs, peculiar inability to connect words heard or read with any memory of their import, and, as could be expected, this impairment occurs when the lower parietal or "angular gyrus" region is the seat of the disease. While this consequence of injury to this part has been long known, I believe this to be the first announcement of the reason for it, and I will predict that the additional offices of this "blank area" will be established as noted below. "Arcuate" connecting fibrils enmesh the brain surface, uniting faculties intricately, in a manner obviously dependent upon the education and other circumstances of the individual. These fibrils and their generating cells may pile up in certain parts and be defective in others; the musician will have more connections between the auditory and motor centres, and the painter between the optic and motor, than others. One whose impulses or springs of action are well subordinated to what he has learned through optic, auditory or other senses, will have greater strands of connections between the sensory and motor brain parts to regulate his deeds than the impulsive or heedless person.

These blank spaces become what might be styled inhibitory regions, in that they restrain acts; they can also more properly be called impulse areas, because they regulate and prompt actions. As they correlate the sense and motor centres, they are also memory areas, as is evident when injury causes words to convey no meaning to the mind. Now, if what we see, feel and hear govern our actions, he who profits best by what he has been taught, or upon whom such teaching makes the best impression, will, *à priori*, have the most abundant supply of arcuate fibrils in this parietal region; such restraint or guidance unavoidably causes acts to be less impulsive, more subordinated to the interests of the individual. If those needs are considered to be best conserved by subservience to others

their approval will tend to regulate acts, a form of cautious deference dominates the person; if a wider, higher and better form of cautiousness, based upon what one considers his highest interests, his higher expediency ideals, whether with reference to this or another world, then the person is said to be conscientious. At this stage of analysis of what these inhibitory or impulse connections involved, I was astounded by recalling that phrenologists group "conscientiousness, approbateness and cautiousness" in the identical place under discussion. The process of arriving at this discovery was by first recognizing inhibition to be but cautious control, and I have long held the idea that conscientiousness was but a higher caution.¹ Startled by noting that phrenologists place them next one another, as they assert, empirically, they having found these eminences to be prominent in persons who were thus scrupulous or guarded, I next observed that "approbateness" is placed behind, but adjoining "caution and conscientiousness." This narration should acquit me of special pleading. Disposed unfavorably, as I was and am, against phrenology, as in the main a pseudo-science, my aim has been to unsparingly criticize it.

This group of alleged bumps in the position the phrenologists assign it is a remarkable coincidence, if it prove to be no more.

I prefer the designation *Impulse and Memory region* until more scientific men than phrenologists agree upon the separation of the area into the divisions, "cautiousness, conscientiousness and approbateness," which cannot be done until we ascertain whether phrenologists lied, were mistaken, or were right in this particular.

"Firmness, Self-esteem, and Continuity" are placed by them over the tonsure or earliest bald spot, beneath which in the brain is the summit of the Rolandic sulcus, injury to which invariably causes paralysis of the opposite side. We can concede that an abundance of arm and leg centres in this region would indicate the possession of self-reliance, nor would it be far-fetched to interpret such control as firmness, scoring another for phrenology; an excess of this might be construed into self-esteem, and if the motor area (as in fact it does sometimes) extend farther occipitally, then this brain centre increase of cells and fibrils serving for better innervation of arms, legs and other parts, might be allowed to constitute

¹ Comparative Physiology and Psychology. A. C. McClurg & Co., 1884.

"continuity" in enabling more prolonged effort. Coincidences that may be justified by a real relationship. *Quien sabe?*

Below and toward the front is "Hope." If thought has its main seat in the frontal region, a prolongation of fibrils thence to control acts with a definite expectation in view, anticipation based upon reason, might justify some such bump as this, and in about that location. "Ideality" seems better placed, farther forward, for a similar reason, and not open to the objection of being located over arm and leg centres, as is "Hope," although arcuate fibrils having many destinations may overlies any part of the brain.

"Benevolence" is placed near or over the anterior fontanelle. As this trait is the outgrowth of sympathy, an acute feeling for others depending upon a thoughtful correlation of past experiences or impressions inherited or acquired, so there *may* be such a swelling in that vicinity.

"Constructiveness" is over the third frontal convolution root, which, on the left side, is the demonstrated seat of language, so the bump is mislocated. A rounding out of the side head above and forward of this could indicate the possession of such a faculty, because it depends upon ingenuity, mechanical ability, etc., a brain and mental breadth.

"Eventuality, Comparison, Causality, Individuality," in the frontal apices, apparently appropriately enough, for cerebral reasons.

The claim that "Amativeness" resides in the cerebellum has been sufficiently disproved by the experiments recorded in Carpenter's *Physiology*, where the cerebrum, and not the cerebellum, decreased in size with sexual loss. Furthermore, the cerebellum has no relation whatever to the posterior protrusion of the skull. A large muscular development is an indication of animality, which may be offset by intellectual balancing. Large trapezius and sterno-cleido-mastoid muscles would have a correspondingly large occipital ridge, and it is over this that the phrenologists locate "Amativeness."

The animal propensities, "Combativeness, Secretiveness, Destructiveness, Alimentiveness and Acquisitiveness" are suggestively gathered over the temporal and auricular muscles, as these muscles are large in rapacious animals. Without admitting the spe-

cial divisions, these animal traits undoubtedly could accompany extra prominence of these muscles in the place assigned to these faculties by the phrenologists, while there is not a cerebral or cranial warrant for the location, palpably when beneath this muscular swelling the skull is often depressed to afford it attachment. "Alimentiveness" is appropriately placed over the temporo-maxillary articulation; a great eater works this vicinity more, and thus may increase its size.

The superciliary ridge may be enlarged by serviceable and associated habit in shielding the eye, frowning while trying to perceive better, and thus indicate perceptive acuteness, but the subdivisions into size, color, etc., require demonstration, as extremely doubtful.

"Form" is said to be shown by width between the eyes. I know good artists who have not this width, and execrable ones who have it. Language does not produce œdema of the lower eye-lids; the faculty is remotely and surely situated under the alleged "Constructiveness."

It would not be profitable to discuss the other bumps, as they seem rather absurd.

We thus alight upon three main character indications, due to brain, skull or muscle prominences, which the phrenologists erroneously call cranial, and regard the brain as the cause of the skull elevations.

Thus, for cerebral reasons, there seems to be a plausibility in the location of

Firmness, Self-esteem, Continuity. Possibly justified by the underlying motor centres for the arm and leg. Cerebral control of the body.

Cautiousness, Conscientiousness, Approbateness. Inhibitory faculties situated over spaces between rearward brain centres.

Benevolence, Hope, Ideality, Constructiveness. Inhibitory or impulse faculties between motor and intellect centres.

Causality, Comparison, Eventuality, Individuality. Intellectual faculties of the fore brain, internuncial fibrils relating other brain parts, correlating impulse areas.

For muscular and cranial reasons there is justification for the grouping of

Combativeness, Destructiveness, Secretiveness, Acquisitiveness, Alimentiveness. Animal traits that can be grouped under Ferocity, accompanied with large-sized temporal and auricular muscles.

Amativeness. Animality, with large neck muscles, occipital ridge and mastoid process.

Perceptives. In proportion to size of eye-brow ridge.

The remaining half of the phrenological faculties appear wholly or nearly wholly, unjustified.

Divested of the less plausible alleged faculties, the remaining ones, when subjected to the crucial test of Herbert Spencer's classifications of the feelings and cognitions, stand the scrutiny quite well, for the presentative feelings can be assigned to the cortical centres for sight, etc., and the impulse areas will include from behind forward the presentative-representative or emotions, the representative as "sublimity," and re-representative such as acquisitiveness, which might tempt us to take the latter out of the temporal muscle and allow it the position assigned by the phrenologists as cerebral. The cognitions similarly classified end in the highest of all, being placed in the apex of the frontal lobe, the re-representative cognitions, aggregations of representations, the appreciation of the general relations of things.

There is something beside generalizations in phrenology hidden beneath a load of trash. In shoveling this away scientific men are apt to jeer the labor; they can be as mulish as the most ignorant in refusing to see what they do not want to know; they are human, as witness the reluctance with which the majority accepted Darwinism, though emanating from a reputable source.

It should not be forgotten that phrenology was founded by good anatomists, and that scientists turned against it because charlatans built error upon it; but quacks have taught us a few things worth knowing.

OBSERVATIONS MADE IN THE CENTRAL
PHILIPPINES.

BY J. B. STEERE.

THE islands of Panay, Guimaras, Cebu and Bojol may well be grouped together and called the Central Philippines. They are geographically connected; their people are of allied races and language, and, as we found, they are closely allied zoologically. With Mindanao on the south, Palawan on the west, Masbate and Mindoro on the north, and Leyte and Samar on the east, they are separated from all these by broad straits, while the channels dividing them among themselves are at their narrowest points nowhere more than five or six miles of continuous sea, and this usually shallow and apparently rapidly changing hues, so that the land areas must have been very different in size and form at a very recent period.

We arrived at the end of December, 1887, at Ilo Ilo, the capital of Panay, and the principal trade centre of the surrounding islands. Soon after we moved over to a pleasant native house on the island of Guimaras opposite. The place was on the beach, at the foot of some steep cliffs of coral, a little brook came tumbling down at one side, while a fine grove of cocoa palms shaded the house. The woods were near, and beautiful sun birds and *Dicaeums* were flying about the palm houses, while several of the most beautiful species of the famed Philippine tree shells were found in abundance on the barn door and other outhouses near by. We were near enough the city to get a supply of fresh meat and bread every morning, and it was the nearest a naturalist's paradise we had yet found. The birds as they came in, though of genera we had already become familiar with in the west and south, were most of them of different species, showing that we had reached a new and distinct area.

The west side of the island is made up of steep, rugged cliffs of limestone, which rise up from two to three hundred feet above the sea. The rock has weathered into crevices and holes, leaving

sharp points standing up, which makes transit very difficult. Inland this rock is broken up by narrow, steep valleys, through which flow the little streams from the centre of the island. The cliffs are full of caves, which seem in most cases to be water courses cut through the rock. We had heard of nests of the edible swallow (swift) in the island, and finally found a wrinkled old Indian who made a living by gathering the nests and selling to the Chinese at Ilo Ilo. The nests are not found, as might be supposed, in those caves opening near the sea, but in those far inland, where the cavity is covered with forest. We went to the nest-gatherer's hut, two or three miles back from the sea, and telling him our object, he provided himself with a torch of native gum (dammar) and another made of the ribs of cocoa palm leaves, and we set out. After half an hour's rapid tramping through the steep, rocky valleys, we came to a low ledge of rock, eight or ten feet high, covered with vines and bushes, and at the foot of this a black hole three or four feet square, leading down into the earth. The opening was just large enough to crawl through, but our guide lighted his torches, and getting down on hands and knees crawled in, and we followed, down a steep, narrow, rocky passage, the channel of a stream in the rainy season. It widened and grew higher as we went down, but was still nothing more than a rift made in the rocks, perhaps by earthquake, and widened by water wear. The rocks were muddy and slippery, and we followed our barefooted guide with difficulty. Still on we went, until all trace of light except from our torches was gone, and it seemed anything but a fitting place for birds' nests. Still we went on, until after we were perhaps a hundred feet below the surface, and several hundred from the mouth of the cave, we began to hear the weak, faint twittering of the little birds as they flew about over our heads, and finally the Indian raised his torch, and we could see in the roof of the cave shallow hollows in the rock, and in these, and partly supported by their sides, the little white, cup-like nests, which the guide began tearing out with his fingers, and stuffing into a pouch at his belt. The birds fluttered about almost in our faces, but he kept on until he had gathered all in sight. None of them had eggs in them, as he had visited the place but two or three weeks before. The nests were pure white in color, made of little fibres interwoven

with each other, and were still soft and damp. How the birds had ever found this place so far from the light, with a dry face of rock, and with suitable digression in it was a wonder, and how they could do this work of nest building in such utter darkness. Coming to the surface we set out again, and after an hour's tramp came to the second cave. This time as we were making our way down a steep, timbered valley, the path all at once dropped out before us, and we were at the mouth of a dark well, leading down almost perpendicularly for twenty or thirty feet at first, when the descent became more gradual. By clinging to the projecting rocks we clambered down, and soon found ourselves in a passage twenty feet high and as many broad. Great masses of rock had fallen from the roof, which made our progress slow. Curious stalactite growths, taking the form of flat plates with saw-tooth edges, were hanging from the roof. After making our way to a still greater depth and distance than before, we again heard the faint noise of the birds, not loud enough to be heard except in such perfect quiet as we were in. It seemed more like the sounds spirits might make than the notes of anything earthly. Soon after we came to a part of the cave where the roof was some eight or ten feet high, and worn into curious and very regular pits, five or six inches deep and as many wide at the mouth, and as smooth and round as if made artificially. In these the birds were building their nests, attaching them to the walls of the pits. Again, in spite of the weak protests of the owners, the nests were torn out and appropriated by our guide.

As we made our way out we passed a stalactitic column a foot in diameter, which had connected the roof and floor of the cave, but had been broken across by earthquake, and the ends separated by half an inch. The thought of being caught away in there in utter darkness by an earthquake, with the rocks grinding and shutting in upon us, was anything but pleasant. Near the mouth of the cave, just where we could begin to perceive a ray of light from the surface, were several nests of cruder, rougher make, being much larger and made chiefly of grass and lichens stuck into the face of the rocks by large masses of the edible gum. The birds are, without doubt, of the same species. The guide said they were sentinels to alarm those within, and that their nests were always

built in that way. The birds are quite abundant in the island, and there are probably many caves which the old man has not yet found. He is said to be the only one who dares enter them, others being deterred by stories of snakes, which are not all stories, for we passed, near the mouth of the second cave, the cast-skin of a snake eight or ten feet in length. There are also stories of a curious little black, hairy people, the Kama Kama, which are invisible at most times, and which inhabit these caves and live on the snails with which the island abounds. The guide pointed out great heaps of empty shells, far in the caves, as proofs of the existence of the Kama Kama, but they looked like shells which had been floated in by high water.

The edible nest (swift) according to the guide, whose account was proved to be correct by our observations as far as they went, nests the year round, lays two small, white eggs, is about a month completing its nest, lays the eggs on the bird edible material of the nest, nests time after time in the same nest, adding to it each time. The young build beside the nest in which they were born, frequently attaching their nest to that of the parents.

The only forest remaining in Guimaras was in the rough gorges and upon the rocky cliffs near the sea, the upper level of the interior of the island being sandy, and much of it in cultivation to sweet potatoes and Indian corn, and in the lower places to rice. The hills of Panay, all about Ilo Ilo, and as far up the mountains as we could see, showed no virgin forest, but only grassy slopes and bushy ravines, a poor outlook for our work. Whether the same conditions have worked like results elsewhere or not, there can be no doubt that the Indian method of cultivation has produced these grassy plains from an anciently heavily timbered country. They cultivate by cutting down the timber and burning it during the dry season, and then planting on the burned and blackened ground. One or two crops are raised before the wild growth gets too strong for their large knives, their only implement of cultivation, and then the timber grows again from the roots and sprouts left in the ground, and the cultivator cuts off another piece of forest. After a few years, if the population is thick enough to demand it, the first piece, now grown up to brushwood twelve or fifteen feet

high, is again cut and burned and planted, and so on over and over again, the tree growth becoming weaker each time, until the coarse grass (cogon) gets in, and with it the annual fires, and then there is an end to Indian cultivation, and where were once tall forests, grassy plains take their place. This process can be seen on any island of the Philippines in all its stages. In some places the people are trying to overcome the cogon with the poor Chinese plows and the buffalo, but it is a slow way, and most of them prefer to move on to the forests again. By this means the central islands, which are the most thickly peopled, have become for the most part covered with grass, while the more sparsely settled islands of the west and south remain in forest.

[TO BE CONCLUDED.]

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.¹

ASIA, ETC.—SUANETIA.—The first article in the June issue of the *Proceedings* Royal Geographical Society is that of Mr. Douglas Freshfield upon Suanetia, which is the Anglicized name of the upper basin of the Ingur, a small river which flows into the Black Sea a few miles east of Sukhum Kaleh. The valley is about forty miles long by twenty wide, and lies between three and four thousand feet above the sea. On its north lie the complicated ridges of the crest of the Caucasus, with such summits as Tetnuld (15,247 feet), Koshtan-tau (17,036 feet), and Ushba. These ridges are composed of crystalline rocks, which show the tendency observable in the Alps to arrange their summits in double lines, in the troughs between which lie vast *névés*. The great glacier basins thus enclosed are named the Zanner, Thuber, Gvalda, and Betsho. These glaciers send down to the Ingur or its tributaries many ice-streams, such as the Adish, which in the Alps would rank as a first-class glacier. On either flank of the rigid granites lie beds of friable schists, whose summits present green rounded outlines, and exhibit a striking contrast to the snowy precipices of the great chain. South of Suanetia rises the lofty slate ridge of the Leila, which runs parallel to the main chain, and attains elevations of 12,000 feet. At its western end this ridge bears some considerable glaciers. The river escapes from the valley at its western end, between high spurs of the two chains, and through a narrow porphyritic gorge not at present passable for horses. To the east the valley of Suanetia terminates in a low grassy down (8,600 feet), only 1,600 feet above the highest villages, and beyond this lies a pathless waste of forests and flowers—the wilderness in which rises the Skenes Skali, a tributary of the Rion (the ancient Phasis). But this outlet is so circuitous that both Russians and natives have preferred the higher and steeper Latpari Pass (9,200 feet), which is the usual route into the valley.

The natives of this secluded spot are first mentioned by Strabo under the name of Soani, and the received text credits them with 200,000 fighting men. Strabo says that the king had a council of 300, and that the tribe used poisoned arrows in war. Whatever the former strength of the nation, the Suaneti, as they now call themselves, did not number more than 12,000 at the last census.

¹ Edited by W. N. Lockington, Philadelphia, Pa.

Over one-third of these live on the upper Skenes Skali, and are more or less merged with the surrounding Mingrelian populations. The Suanetians are not in the odor of sanctity. At best they are sheep-stealers and cattle-lifters. They were converted to Christianity before the tenth century, but may now be fairly described as reverted pagans. Seven hundred years ago Suanetia formed part of the kingdom of the famous Georgian Queen Tamara, in whose honor the Suanetians still chant ballads. For awhile it was connected with Mingrelia, but at some time in the last century it became entirely unattached, and the upper part of the Ingur valley still bears the name of Free Suanetia. The country is covered with small chapels, dating probably from the 11th and 12th centuries, but these are no longer used as churches, but as treasure-houses. Long before Suanetia had obtained home rule, it had disestablished its church. An hereditary caste of local elders took the place of the priests, and a village vestry assumed the control of the ecclesiastical property and kept the keys of the church, which contain many curious and some beautiful works of art. Services and sacraments followed the priests. Marriage consisted in sewing together the garments of the bride and bridegroom, and the ancient funeral ceremonies were revived. There are traces of tree-worship and also of that of the heavenly bodies. The natural tendency of the population to increase beyond the supporting powers of the territory was effectually checked by placing a pinch of ashes in the mouth of every superfluous female baby. Russia assumed suzerainty over this district in 1833, and has gradually tightened her sway, appointing headmen or *starchinas* in every commune, and establishing several schools, as well as placing its representative at Betsho in a position to command some respect and obedience. The Suaneti are rather a farming than a pastoral people, though they keep a few flocks of sheep and herds of horses. There does not seem to be a prevalent type among the people. There are fair men with tawny beards, dark men, men that look like Persians and men that resemble figures from an Assyrian monument. The criminal refugees that have for centuries found a sure retreat in this mountain Alsatia have so obscured the traces of the original stock that it is difficult to tell whether that stock was Georgian or Colchian. Mr. Freshfield, on account of the resemblance of the Suanetian tongue to the Early Georgian, accepts the former view.

The architecture of the Suanetian villages is striking. Towers and castles abound. Mestia has seventy towers forty to seventy feet high; Ushkul about fifty and two castles. The towers, constructed for defence, are of untrimmed black slate, and are attached to houses built of the same material.

THE SOLOMON ISLANDS.—The Solomons lie about five hundred miles east of New Guinea, and extend for six hundred miles northwest and southeast, between the meridians of 154° and 163° E. longitude, and the parallels of 5° and 11° S. latitude. They were discovered and named by the Spaniard Mendana, in 1567. There are seven principal islands (Bougainville, Choiseul, Ysabel, Malayta, San Christoval, Guadalcanar, New Georgia) and several smaller ones. The total area of the group is estimated by Mr. C. M. Woodford, who has recently returned from a lengthened residence among them, at 15,000 square miles, but they may still be considered as to a great extent unknown. Dr. Guppy, who has recently written a valuable work entitled "The Solomon Islands; their Geology, general Features, and suitability for Colonization" was attached to a man-of-war, but Mr. Woodford resided among the natives, engaged in collecting birds, mammals, etc., and was thus exposed to many dangers among a people who are given to head-hunting and cannibalism. The island of Savo was an active volcano when discovered in 1567, and at the present time has hot springs, which also occur upon Simbo and Vella Lavella, while Kulambangara is an extinct volcano. There is an active volcano near the centre of Bougainville. On this island, which is the largest and most northerly of the group, the mountains rise to a height of 10,000 feet, on Guadalcanar to 8,000 feet, and on the other large islands to from three to five thousand feet. The islands are mostly clothed with dense tropical forest from the coast to the mountain tops. Records kept by traders at Ugi and Santa Anna show that the annual rainfall is from 100 to 150 inches per annum. Mr. Woodford stayed awhile upon the islands of Alu, Fauro, New Georgia and Guadalcanar, on the last of which he lived half a year. Here he explored the rivers Aola and Kobua, and got a bearing of the peak Vatapusan (4,360 feet).

The natives are mostly of the Papuan type, with some admixture of the lighter Polynesian. The men wear no clothes save the T bandage so common among savage races, and many do not even wear this. On San Christoval and Malayta the women have a plaited square of grass fibre about six inches by four suspended round the waist, but some go absolutely naked. On Guadalcanar the females are invested in a series of superposed fringes. Many of the natives pierce the lobe of the ear, and enlarge the opening till it attains a diameter of two inches or more. The canoes vary in size from one just large enough to carry a boy of twelve to the great head-hunting canoes, capable of carrying fifty or sixty men. They are adzed down from the solid tree, sewn together with a tough vegetable fibre, and caulked with a putty scraped from the kernel of the nut of *Parinariu laurinum*. The use of stone implements seems to have gone out, except perhaps on Bougainville,

a plane-iron being now employed to serve as the blade of an adze. On Savo the megapode or mound-builder lays its eggs upon two sandy patches of open ground, and nowhere else on the island. These laying-grounds are fenced off into small divisions for various owners. In New Georgia and the adjacent smaller islands the passion for head-hunting is such that no canoe can be launched without a head being obtained. The chief hunting grounds are the large islands of Choiseul and Ysabel, which have been nearly depopulated by the practice.

GODWIN-AUSTEN PEAK.—The second highest mountain known to exist on the earth's surface is as yet unnamed, unless the letters K², by which it was characterized by the surveyors who discovered and fixed its position nearly thirty years ago, can be called a name. Attention to this unnamed and unknown condition of the second mightiest elevation of the world, 28,250 feet above the sea-level, was called through the reading of Lieutenant Younghusband's account of his adventurous passage over the Mustakh Pass on his way from China to India. General J. T. Walker (late Surveyor-General of India), has proposed that the peak be named Godwin-Austen, after the first surveyor of the Mustakh ranges and glaciers, and the proposition received the assent of the meeting of the Royal Geographical Society.

A route practicable for road or rail has been found from Assam to Upper Burma, across a belt of dense tree jungle and mountain, which lies between the last British station in Assam and the summit of the Patkoi range.

AFRICA.—THE CAMEROONS.—M. Valdau, a Swedish colonist of the Cameroons, explored the northern slopes of the range in the early part of 1887, and found that the main chain does not extend as far as 4°30' N. Latitude, since the highest point attained by him, about 4°28' N. Latitude, only measured 2,850 feet. M. Knutson, another Swede, in July last discovered the mouth of the river Memeh, which had previously been supposed either to be a tributary of the Rio del Rey, or of the Rumbi. Its embouchure is a little to the south of that of the Rumbi. M. Knutson ascended the river, which he found to be navigable for about thirty miles, as far as the Düben Falls, 100 feet in height.

SENEGAMBIA.—French explorers and surveyors have been busy in Senegambia. The country of Bondu, hitherto known only from the itineraries of Mungo Park and others, has been thoroughly surveyed by M. Fortin and Leforte; and the district of Bambuk, which two years ago was the least known part of French Sudan,

has been completely surveyed by a large party of officers. This region occupies the territory between the Faleme, Senegal, Bafing, and the country of Konkadugu, but its population is only 20,000. The divide between the Senegal and the Gambia was explored by the military columns which operated against the Marabout Mahmadu Lamine. It consists of undulating plains of small elevation, with stony patches at intervals, and contains five small confederated states, with a population of about 13,000. South of Bambuk Captain Oberdorf has explored the Upper Gambia to 12° S. Latitude, and also the upper courses of the Faleme and the Bafing, two important tributaries of the Senegal. Existing maps, especially as regards the Faleme, will have to be considerably altered. This river does not rise in the plateau of Timbo, but in the Koy Mountains. The Tene, hitherto regarded as the upper course of the Faleme, is an affluent of the Bafing. The large tributaries of the Senegal have some fine open reaches, but their navigability is prevented by frequent rapids and falls. Captain Oberdorf concluded treaties with all the tribes visited, save those of Koy. Lieutenant Reichemberg visited Konkadugu, Bafe, Solu, and the left bank of the Bafing. Valuable auriferous bearings are reported from the first of these districts. Captain Peroz, whose mission was directed southeast of that of Captain Oberdorf, surveyed the valley of the Milo as far as Bissandugu, and also the Bure and Upper Bafing, but the chief result of his efforts was the conclusion of a treaty with Almanay Samory, by means of which the French possessions are extended to the banks of the Niger and the Tankisso, and the French protectorate to the confines of Liberia. Lieutenant Quinquandon and Dr. Tautain, who were sent to visit Great Beledugu and the left bank of the Niger, visited Murdia, Gumba, Segala, and Sokoto, and report that the soil becomes less and less fertile towards the northeast, where the country is analogous to Southern Algeria.

EUROPE.—THREE DAYS ON THE SUMMIT OF MONT BLANC.—A party of French meteorologists spent three days of July, 1887, on the summit of Mont Blanc. They were accompanied in the ascent by twenty-four bearers, of whom all but two deposited their burdens upon the summit and immediately departed. In the ascent of the last hill, M. M. Vallot and Richard were attacked by mountain sickness and did not recover for several hours. In a small indentation between the dome of the summit and the ridge by which it is reached the observers pitched their tent. During the first night M. Vallot attempted to fix the instruments, but was driven back by the wind and snow. During the next day he was more successful. While on the summit the health of the party was not very good, yet numerous physiological and meteorological observations were made. On July 30th a terrible thunder storm raged around them for several hours.

THE GERMAN POPULATION.—M. Ch. Grad (*Revue Scientifique*, April 14th, 1888), gives the number of German-speaking people within Germany itself at 41,512,000, and the entire German-speaking population of Europe at 60,000,000. To make up this total we have 8,000,000 in Austro-Hungary, 1,900,000 Swiss, 860,000 Russian Germans (625,000 of whom are Jews), 4,270,000 Hollanders and Luxemburgers, 3,400,000 Flemings (300,000 of whom are in France), and 30,000 Germans resident in Belgium. The number of Germans in Europe has doubled since 1820, in spite of the emigration. The 3,722,000 non-German speaking individuals enumerated at the last census by no means represents the actual extent of the Slavic element, since the whole course of the history in the provinces east of the Elbe has been one of Germanization of an originally Slavic population.

THORODDSEN'S EXPLORATIONS IN ICELAND.—M. Thoroddssen has contributed to Petermann's *Mitteilungen* an account of his exploration of the northwestern peninsula of Iceland in 1886. This part of Iceland forms a table land, averaging rather more than 2,000 feet in height and broken up by fjords the sides of which are almost perpendicular. Nearly every fjord has distinct terraces representing ancient coast lines, now high above the sea. Banks of shells identical with those now living in the sea, and skeletons of whale and walrus have been discovered in these terraces. The Glamujökull glacier, which once measured 120 square miles, has shrunk to half its former size, while one of the glaciers of the Drangajökull has also shrunk from sixty to thirty square miles. From measurements made from the end of the Reykjartfjörð glacier, the traveler found that it had retreated 1,600 yards during the last fifty years. From Furufjörð to the North Cape the coast is formed by a stretch of basaltic rock, 1,300 to 1,600 feet high, traversed by deeply eroded grassy valleys, some of which are inhabited. The dwellers in these valleys live principally by catching sea birds. The Horn Mountain (North Cape), is the highest resting-place in Iceland.

A DISCOVERY IN THE ARCTIC OCEAN.—According to the organ of the Geographical Society of Stockholm, Captain Johanne- sen, last summer succeeded in reaching an island, situated to the east of Spitzbergen, in 80°10' N. Latitude, and 32°3' E. Longitude. This island is a table-land rising to 2,100 feet, and is supposed to be the same as Hvide O, seen by Captain Kjeldsen, and also by Captain Sorensen on August 28th, 1884. This discovery confirms the existence of an archipelago extending from Spitzbergen to Franz Josef Land, preventing the ice from descending into the Barents Sea, and thus having a great influence over the climate of Europe.

GEOLOGY AND PALÆONTOLOGY.

ROMANOVSKY'S MATERIALEN ZUR GEOLOGIE VON TURKES-TAN.—Scattered notes of the geology of Central Asia have from time to time been given in these pages, but M. Emm. de Margerie's *Compte-rendu de publications relatives à la Géologie de l'Asie et de l'Amérique* now gives us the opportunity to give a fuller account. MM. Mushketoff and Romanovsky, after having explored with great thoroughness the possessions of Russia in Central Asia, have published a part of their results. The first volume of M. Mushketoff's orographical and geological description of Turkestan appeared in 1886, while the first number of M. Romanovsky's *Materialen zur Geologie von Turkestan* was issued in 1880. M. Mushketoff considers the natural limits of Turkestan to be as follows: the Mougodjar mountains and the plateau of Ust-Urt to the west; the Tsungarian Ala-tau, the chains of the Tian-shan and the Pamir to the east; the Kopet-dagh and the mountains of Khorrassan to the south; and the Tarbatagai, Zenghis-tau and the watershed between the Aral and the affluents of the Irtish to the north. The space comprised within these boundaries consists of two unequal parts, separated by the crest of the Kara-tau: the northern part, about one-third of the total area, corresponds to the basins of Lake Balkash and of other smaller lakes, while the larger southern part forms the Turan or basin of the Aral. The latter is divided by the Nura-tau into two portions: the basins of the Syr-daria and of the Amu-daria, the latter twice the size of the former. The reliefs of Turkestan pass from the N. E.—S. W. direction to that of N. W.—S. E. by insensible gradations, so that they form bundles of folds having their convexity turned towards the south, as in the chains of northern India. There are three principal groups of folds, the Tarbatagai, the summits of which do not pass 2500 metres; the Tian-shan in the centre, with summits reaching 5000 metres, and even 7300; and in the south the Pamir with a central crest reaching 4500 to 5000 metres, and with some summits of even 8000. Notwithstanding the diversity of the rocks that enter into its constitution, the Turanian basin presents a monotonous and but slightly varied geological structure, since Cretaceous, Tertiary, and post-tertiary deposits cover ninety-five per cent. of the surface, the older formations appearing only as masses here and there piercing the uniform mantle of modern sediments. Above the Palæozoic rocks, with a very noticeable unconformity, lies a series of deposits with fossil plants, evidently a prolongation of the plant-bearing series of Afghanistan, and of the Gondwana group of Hindostan. During the Jurassic period the Turan formed a great island, extending far to the east, where scattered lagoons received

sediments of small thickness; these sediments accumulated along the southern coast of the emerged land, but, as in Afghanistan, cover only a comparatively small area. Beds of lignite are abundant in the lower parts of the Trias-jura, as, for example, on the flanks of the Kara-tau and all around the Fergana basin, and in the absence of the true coal-measures, may prove of economical importance. The Jurassic is conformably covered by the Cretaceous and Tertiary beds, which reach a thickness of 650 metres in Fergana, and even 1600 in Hissar. These two series are so intimately linked that it is impossible to fix a precise line of demarcation between them, and both alike have been affected by dislocations which are well-marked near the mountains, but die out in the centre. The Cretaceous series comprehends very varied rocks, those of the plains differing much from those of the Tian-shan, where they consist chiefly of marls and limestones, the latter often shelly, but becoming oolitic and compact more to the east; the marls often enclose gypsum. It is in Fergana that the Cretaceous presents the greatest diversity of faces, but as fossils are rare and in poor condition, it is difficult to separate the series into stages.

GENERAL — THE GEOLOGICAL STRUCTURE OF AFGHANISTAN. — M. Griesbach, Geologist of the Afghan Boundary Commission, has at various times published in the Records of the Geological Survey of India preliminary notes upon the geological structure of those portions of Afghanistan visited by him. These facts have been brought together by M. de Margerie in his *Compte-rendu de Publications relatives à la Géologie de l'Asie et de l'Amérique*, in such a manner as to give what appears a tolerably clear picture of the geological structure of this mountainous country. The principal crest of Afghanistan is formed by the Hindu-Kush and the Koh-i-Baba, the latter of which is continued into Persia, by chains running to the northwest. Although the greater part of the country is as yet geologically unexplored, the researches of M. Griesbach are sufficient to afford a good index to the character of the remainder. It thus appears that the palæozoic and older mesozoic rocks only come to the surface on the line of the main axis, the rest of the country being occupied mainly by cretaceous beds, often unconformable to the older mesozoic beds upon which they repose. Extensive surfaces in the north and west are covered by tertiary deposits. The region between the main chain of Afghanistan and the next most important series of elevations, viz., that which runs parallel to the Indus, is occupied by a number of antilinal folds, crowded together in the region of Cabul, but spreading outwards fan-like as they approach the frontier of Persia. Most of the rivers found their present courses in miocene times, since which they have eroded deep ravines, while in the meantime the great antilinal folds have be-

come more accentuated. North of the main axis lie a series of parallel folds, narrow and lofty near the centre, but gradually spreading as they recede from it until they become broad and low undulations. The geological structure of Persia seems to be a continuation of that of Afghanistan. The oldest fossiliferous deposits as yet known belong to the Carboniferous system. Wherever examined, the Carboniferous outcrops are, like all the great bands extending from Armenia to the Himalaya, of marine origin. Above the Carboniferous beds lie a number of conformable deposits composed of marine beds alternating with littoral and fresh-water layers enclosing lignite and abundant remains of terrestrial plants. The exact classification of these beds has not yet been attempted, but they are surmounted conformably by undoubted Neocomian deposits, and their lower schistose portion is regarded by M. Griesbach as representing the Permian and Lower Trias; while Jurassic fossils have been discovered in the upper part. Great eruptive activity seems to have characterized the end of this series of littoral beds.

PALÆOZOIC.—E. N. S. Ringueberg (*Amer. Geol.*, May, 1888) gives reasons for considering the Niagara Transition Group as nearer to the Niagara than to the Clinton which underlies it, this affinity being determined by the increased number of Niagara molluscs found in it. The Niagara shales themselves can, upon palæontological evidence, be divided into three parts, each characterized by a regular upward decrease of the fossils. The lower third contains, with very few exceptions, all the species to be found throughout the entire group. A few valves of *Orthis lynx* have been found in the lowest third. The close of this lowest third is marked by a band characterized by the small crinoid *Homocrinus parvus*. *Hemicystites parasiticus*, parasitic upon *Spirifera niagarensis*, has not been found elsewhere by the author of the paper. The second and third divisions are chiefly defined by negative evidence, yet *Homalonatus* reaches its maximum size after leaving the *Homocrinus* band, and the few specimens of *Cornulites* and *Stomatopora* are mostly from within its borders, as is also the case with *Tentaculites niagarensis* and *Beyrichia spinosa* and *B. symmetrica*, which trio extends into the upper third. In the upper third corals are scarce, cephalopods almost entirely wanting, and crinoids excessively rare. *Rhynchonella neglecta* and *Streptorhynchus subplanum* are two of the most constant fossils, which attain their best development in this division.

Cælosteus ferox is the name given by Prof. Newberry to a large species of fish, apparently allied to *Dendrodus* and *Rhizodus*, of which the jaws, teeth and bones were discovered in the Lower

Carboniferous Limestone at Alton, Ill. The lower jaw is about a foot long, an inch and a half wide in front, and widens to four inches behind. It is marked on the upper margin by a series of broad, shallow pits, for the insertion of few but large teeth. The jaws, as well as a large bone, probably a coracoid, consist of a thin shell of bone, enclosing a large area, which was doubtless occupied by cartilage. The dentary differs from that of *Rhizodus* in being entire.

Titanichthys clarkii Newb., discovered by Dr. W. Clark near Berea, O., exceeds in size even the *T. agassizii* of which drawings were exhibited at the meeting of the American Association at Montreal, 1882. The broadly triangular cranium measures five feet or more between the posterior lateral angles. It is concave behind, and the central part of the arch is marked by a broad depression as in *Dinichthys*. The condyle of the post-temporal bone is horizontal and broad, and is clasped in a furrow at the angle of the cranium. The post-temporals are a foot and a half wide, and, as in *Dinichthys*, are overlapped by the clavicles below and by the dorso-median plate above. This plate is sub-circular, and has a long, slender, furrowed process projecting backward and downward. The sub-orbital bones are eighteen inches long, the mandibles three feet. The posterior end of the mandible is spatulate, six inches wide, and turned upward; the anterior end is turned up like a sled-runner, and is excavated by a deep furrow somewhat as in *T. agassizii*, but the whole jaw is much heavier and broader. The under side of the body was protected by a triangular plate three feet long and nearly as broad, having a deep sinus posteriorly and a rounded projecting angle near the middle of either side.

MESOZOIC.—Mr. A. S. Woodward (*Quart. Jour. Geol. Soc.*, May, 1888) describes *Semionotus capensis* and *Cleithrolepis extoni*, both from the Stormberg Beds (Early Mesozoic) of the Orange Free State. The only species of *Cleithrolepis* before described, is *C. granulatus*, from the supposed Triassic Hawkesbury Beds of New South Wales. The South African specimens afford sufficient data to prove that the genus must be placed with the Dapediidae.

A. Weithofer describes in the *Annals of the Naturhistorischen Hofmuseum of Vienna*, a new Dicynodont (*Dicynodon simocephalus*) from the Karroo formation of South Africa. The specimen is unfortunately only an imperfect half of the cranium, lacking the lower jaw, yet it offers characters which distinguish it from the species described by Owen. The parietal region is very highly developed, rising eleven centimetres, or more, above the line con-

necting the mastoid and the frontal, whereas in *D. pardiceps* Owen it only rises 5.5 cm. over the same level. The frontals are less developed than in *D. leonticeps*, the orbits are deeply sunk, and the nasal openings are placed far forward, so that it is one of the most peculiar representatives of the group. The entire occipital region and the bones of the under side are wanting.

J. S. Newberry (*Trans. N. Y. Acad. Sci.*, 1887) gives an account of the fauna and flora of the Trias of New Jersey and the Connecticut valley. About a hundred kinds of tracks of reptiles and amphibians have been found on the layers of sand which at one time fringed the triassic estuaries. These impressions vary from an inch to nearly two feet in length, and are for the most part three-toed, but in some cases are four- and five-toed. Alternating with the barren red sandstones and shales are some layers of dove-colored shale, which contain much organic matter, a few impressions of plants (of which thirteen species have been identified), and large numbers of the remains of fishes. All but two of the plants have been found in the Trias of Virginia and North Carolina. Prof. Fontaine has shown that the plants of the Richmond basin have greater affinity with those of the Rhaetic beds of Europe than with those of any other horizon, and has inferred that the southern extension of our Triassic rocks hold the same position in the geological scale.

The fishes of our Triassic strata belong to six genera, viz., *Diplurus* (1 sp.), *Ischypterus* (18 sp.), *Catopterus* (5 sp.), *Ptycholepis* (1 sp.), *Acentrophorus* (1 sp.) and *Dictyopyge* (1 sp.). Of these *Diplurus longicaudatus* Newb. was a large *Celacanth*, reaching a length of three feet, and is closely allied to *Holophagus* Egt., of the English Lias.

All the species are distinct from any known in the Old World, but a species of *Ptycholepis* allied to ours is found in the Lias of Boll, Wurtemberg, and a species of *Dictyopyge* has been described from the Keuper of Germany. *Catopterus* seems to be distinct from any genus of fossil fishes found in the Old World, but *Ischypterus* is very near to *Semionotus* Ag., which is represented by species in both the Lias and Trias of Europe. *Acentrophorus* Traq. seems to differ from *Ischypterus* only in the absence of the spiny scales along the dorsal line. *A. chicoensis* is named from the Chicopee Falls, Mass., where it is found.

Geo. F. Becker (*Bull. Cal. Acad. Sci.*) replies to Messrs. Hague and Iddings' criticisms upon his conclusions respecting the pyroxenic rocks of Washoe. The former geologist sees in these rocks evidences of two separate eruptions, and therefore divides them into diabase and andesite, while the latter geologists consider both

of these masses as substantially a single Tertiary eruption. Mr. Becker claims to have found additional reasons for maintaining the existence of diabase, and also for dividing the pyroxene andesite into two distinct outflows, separated by a long interval of time. At Steamboat Springs, about six miles from Virginia City, occurs an extensive series of sedimentary beds, nearly vertical, with a strike following the general direction of the Sierra. Andesites and basalts have broken through and overlie these beds, which are without trace of fossils, and are evidently pre-tertiary. Indeed, they appear to be as old as the rocks determined as Jura-Trias by the geologists of the fortieth parallel. These sedimentary beds contain pebbles of the exact character, both physically and mineralogically, with the east wall of the Comstock lode, determined by Becker as porphyritic diabase. The presence of these pebbles in beds of pre-tertiary age proves that there must be real pre-tertiary diabase somewhere in the neighborhood of Mt. Davidson. This locality is substantially in the same district as the Comstock lode, and, according to Mr. Becker's investigation of the faulting action on the Comstock, formerly received the drainage from the diabase area at Virginia.

The first number of Band xxxiv. of *Palæontographica* contains a description of some fossil remains of Chimæridæ in the Museum of Munich. These remains comprise some species of *Ischyodus* previously known, and also *Ischyodus ferrugineus*, nov. sp., and *Edaphodon kelheimensis*, nov. sp., as well as *Chimæropsis paradoxa* Zittel.

In the thirty-fourth part of *Palæontographica*, E. Holzapfel describes the molluscs of the Cretaceous of Aachen, prefacing his account with descriptions of the strata and lists of the species contained in each.

Dr. Rust (*Palæontographica*, Band xxxiv.) adds an important contribution, illustrated with eight plates, to the knowledge of the Radiolaria of the Cretaceous. Whilst in the Jura the oldest and newest beds are richer than the middle, in the Cretaceous the oldest stages are the richest. The Neocomian and Gault are especially rich. Out of a total of 165 species described in Dr. Rust's monograph, 59 are found in the Neocomian, 109 in the Gault, and only six in the upper stages of the system.

CENOZOIC.—Prof. J. Prestwich (*Quart. Jour. Geol. Soc.*) gives a table of the accepted classification of the Eocene series in England, Belgium, and the Paris basin, and states his reasons for some adverse conclusions. The sands and marls of Heers (Bel-

gium) are usually considered as a separate horizon, but Prof. Prestwich points out that there is nothing in their molluscan fauna to warrant them as older than the Landenian, while the presence of sixty-two plants, all but one new and peculiar to the locality, may be simply due to the proximity of land. He objects also to the correlation of the Sables de Bracheux with the Lower Landenian and Thanet Sands, pointing that out of the eighty-two species of mollusca found in the Bracheux Sands only six seem to be common to the Thanet Sands and five to the Lower Landenian, while ten are found in the Woolwich beds. A table gives Prof. Prestwich's views upon these and other points in the correlation of these important beds of the London, Belgian and Parisian basins.

A. Weithofer has recently described several species of bats from the phosphorites of the central plateau of France, including *Pseudorhinolophus*, sp., *Alastor heliophigas*, nov. gen. and sp., *Rhinolophus dubius*, *Vespertiliavus*, sp., *Taphozous*, sp., *Neoremantis adichaster*, nov. gen. and sp. Fossil Cheiroptera, like fossil birds, are rare.

A. Gaudry and Mar-Boule, in their third fascicule of *Matériaux pour l'histoire des temps Quaternaires*, call attention to the destruction of forests which resulted from the sands, clays and rocks brought down by the glaciers, forming a soil without vegetable humus, which even now is with difficulty made productive. What the moraines spared the cold completed, so that only herbage and shrubs could grow upon a soil which, as in the Siberian tundra, was frozen even during the summer at a certain depth. To meet this change in the character of the vegetation the type of the Rhinoceros was gradually modified into that of the Elasmotherium, which may be characterized as an intensely herbivorous Rhinoceros. The cranium of the Elasmotherium is larger than that of *Rhinoceros tichorhinus*, the example in the Museum of Paris measuring 98 centimetres in total length. The sinus of the frontal bones is developed into an enormous rugose protuberance, which probably supported a huge horn. The parietals take no part in the composition of this prominence, but are forced back by it, and are very much reduced. The nostrils are completely separated by a septum, and the nasals are narrow and smooth, showing that they did not bear a horn, as was the case in *R. tichorhinus*. The extremity of the intermaxillaries is largely developed, indicating the presence either of a proboscis, as in the tapir, or, as believed by our authors, of a prehensile lip. The twenty molars of Elasmotherium have longer crowns, and are much more complexly folded than those of any rhinoceros.

BOTANY.¹

THE FLORA OF PALESTINE.—A general opinion seems to prevail, even among those who have visited the country, that though flowers are abundant in Palestine, especially during and immediately succeeding the rainy season, yet the number of species is remarkably small. This idea as to the paucity of species is scarcely correct. The multiplicity of species, and the large variety of peculiar forms are, in fact, in many cases, noticeable features of the flora.

As an example, I may state that I have collected, in the immediate vicinity of Jerusalem, eleven species of *Geranium*, including the *G. tuberosum*, that very distinct species with tuberous root. In this group, as in most others, the differentiation of the species is remarkably pronounced, being displayed not only in the form, color, number, furnishing and disposition of the blossoms, but also being exhibited in the great variation of the leaf, and even sometimes, as in the case of the species mentioned, passing into the character of the root.

I have had my attention attracted by the great number of cruciferous plants, as also those of a prickly or thorny nature. Indeed, genera whose species in other countries are usually smooth and unarmed, are here represented by species having prickly, spinous, or thorny appendages. It may be considered significant that in this land, where the great event (the central thought of Christianity) occurred, the plants should be found so frequently bearing the cross and wearing the thorns.

The number of garden plants which here grow wild has been commented on. To-day, I found on the rocky hills around Jerusalem the Narcissus and the Scarlet Anemone, Cyclamens, and the little blue-gray Iris, all in blossom. The Narcissus as well as Almond had been in flower for more than two weeks, and the Crocus and Orange for months; the fruit of the latter (confined to gardens) having been ripe since November. The Asphodels were pushing up their long stalks, heavy with buds, from among their spear-like leaves; and the purple Bugloss (*Echium violaceum*) hung from the cliffs. The very rocks seemed breaking out into blossom and praise.

In northern Palestine, in the months of March and April, after the effect of the rainy season has been felt, the bursting of the land into flower is a sight never to be forgotten. I have ridden on horseback, hour after hour, day after day, through miles of Scarlet Anemones and Ranunculus, Lupine, Scabious and Pheasant's-eye. Patches of vividly red Poppies, with fine black maculations, like eyes, edged with white, made matchless streaks of color. The

¹ Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

purple *Gladiolus* sent up its graceful spires in the fields, and along the roadside trailed with great crimson bells the *Convolvulus jalapa*, and the smaller belled white *Convolvulus* with pale sulphur-colored rays. To see the Tulips (*Tulipa gesneriana*) breaking out of the hard dry soil of the very pathway, was a wonder, recalling the well-remembered description in Isaiah: "The wilderness and the solitary place shall be glad for them; and the desert shall rejoice and blossom as the rose." No artist, not even Turner himself, could do justice to the glorious colors of the landscape.—HENRY GILLMAN, U. S. Consul, Jerusalem, Palestine, February 10th, 1888.

✓ THE ENTOMOPHTHOREÆ OF THE UNITED STATES.—These parasitic plants have been studied by Roland Thaxter, who has embodied his results in a monograph published in the Memoirs of the Boston Society of Natural History, Vol. IV., No. 6, bearing date of April, 1888. The order is now known to be a Zygomycete, related to the Mucorini, instead of Oöphyte with close relationship to the Saprolegniaceæ. This Thaxter confirms by his beautiful drawings of Zygospores, produced by a true conjugation.

The twenty-eight species described are arranged under three genera, viz.: *Empusa*, *Massospora*, and *Basidiobolus*. The name *Empusa*, proposed by Cohn in 1855, is very properly adopted in place of *Entomophthoræ*, proposed by Fresenius in 1856. Sixteen new species are described, all of which belong to the genus *Empusa*. A synopsis, with hosts, as follows, may be of value to collectors and students:—

1. *Empusa muscæ* Cohn.—"Diptera: *Musca domestica*, *Lucilia cæsar*, *Calliphora vomitoria*, and other large flies; also Syrphidæ of several genera."
2. *Empusa culicis* A. Braun.—"Diptera: Imagines of *Culex* and numerous genera of minute flies or gnats."
3. *Empusa grylli* (Fresenius) Nowakowski.—(*Entomophthora ulicæ* Reich. and *Entomophthora calopteni* Bessey.) "Lepidoptera: Larvæ of many genera of Avatiens and of *Orgyia nova*. Orthoptera: Larvæ, pupæ, and imagines of many genera of Acridians. Imago of *Ceuthophilus*. (?) Diptera: Larvæ and imagos of Tipulidæ, etc."
4. *Empusa tenthredinis* (Fresenius) Thaxter.—"Hymenoptera: Larvæ of Tenthredinidæ."
5. *Empusa conglomerata* (Gorokin) [?] Thaxter.—"Diptera: Larvæ and imagines of Tipulæ."
6. *Empusa apiculata* Thaxter.—"Lepidoptera: Larva of *Hyphantria textor*, imagines of *Fortrix* sp., *Deltoid* sp., *Petrophora* sp. (Geometrid). Diptera: Numerous genera of small flies or gnats. Hemiptera: Imago of a species of leaf-hopper (*Typhlocyba*)."

- Var. *major* Thaxter.—“Coleoptera: Imago of *Ptilodactyla serricollis*.”
7. *Empusa planehoniana* (Cornu) [?] Thaxter.—“Hemiptera: Several genera of Aphides.”
 8. *Empusa papillata* Thaxter.—“Diptera: Several minute gnats.”
 9. *Empusa caroliniana* Thaxter.—“Diptera: Imagines of *Tipula* sp.”
 10. *Empusa fresenii* Nowakowski.—“Hemiptera: *Aphis mali* and very many other aphides.”
 11. *Empusa lageniformis* Thaxter.—“Hemiptera: Usually aphides on *Betula populifolia*.”
 12. *Empusa lampyridæum* Thaxter.—“Coleoptera: Imago of *Chauliognathus pensylvanicus*.”
 13. *Empusa geometralis* Thaxter.—“Lepidoptera: Imagines of geometrid moths (*Petrophora*, *Eupithecia*, *Thera*, etc.).”
 14. *Empusa occidentalis* Thaxter.—“Hemiptera: Aphides on *Betula populifolia*.”
 15. *Empusa sphærospermia* (Fres.) Thaxter (*E. radicans* Brifeld, *Entomophthora phyttonomi* Arthur).—“Lepidoptera: Imago of *Colias philodice*; larva of *Pieris*. Hymenoptera: Ichneumonidae of several genera and species, a small bee (near *Haliectus*). Diptera: Imago of *Musca domestica*, *Musca* sp.; numerous small species belonging to the Culicidae, Mycetophilidae, Tipulidae, and other families. Coleoptera: Larva of *Phytonomus punctatus*; imago of one of the Lampyridæ. Hemiptera: *Aphis* sp.; several species of *Typhlocyba* (leafhoppers), larvæ, pupæ, and imagines. Neuroptera: Imago of *Limnophilus*. Thripidae: Larvæ, pupæ, and imagines of a species of Thrips on *Solidago*.”
 16. *Empusa aphidis* Hoffman.—“Hemiptera: Aphides of numerous genera.”
 17. *Empusa depterigena* Thaxter.—“Diptera: Small Tipulæ; other small flies or gnats, belonging especially to the Mycetophilidae.”
 18. *Empusa virescens* Thaxter.—“Lepidoptera. Larvæ of *Agnotis fennica*.”
 19. *Empusa americana* Thaxter.—“Diptera: *Musca domestica*, *M. vomitoria*, *Lucilia cæsar*, and numerous other large flies.”
 20. *Empusa montana* Thaxter.—“Diptera: A minute gnat, apparently Chironomous sp.”
 21. *Empusa echinospora* Thaxter.—“Diptera: Imago of *Spromyza longipennis*, and (rarely) other smaller Diptera.”
 22. *Empusa sepulchralis* Thaxter.—“Diptera: Imagines of Tipulidae.”
 23. *Empusa variabilis* Thaxter.—“Diptera: Minute gnats of various genera.”

24. *Empusa rhizospora* Thaxter.—“Neuroptera: Several genera of Phryganeidae (imagines).”
 25. *Empusa gracilis* Thaxter.—“Diptera: On very minute gnats.”
 26. *Empusa conica* Nowakowski.—“Diptera: Imagines of Chironomus and other small gnats.”
 27. *Massospora cicadina* Peck.—“Hemiptera: Larvæ, pupæ, and imagines of *Cicada septendecem*.”
 28. *Basidiobolus ranarum* Eidam.—“On the excrement of frogs.”

Collectors may be able to add to the species given above. As Mr. Thaxter desires to continue the investigation of the Entomogenous plants of North America, he desires correspondence upon this subject, with specimens in quantity. He should be addressed at New Haven, Conn. This little group ought now to receive a considerable attention at the hands of our botanists.—*Charles E. Bessey.*

A MINIATURE TUMBLE-WEED.—On the great plains of Nebraska, from the altitude of two thousand five hundred to three thousand feet above sea-level, to and throughout the Rocky Mountain region there grows the very pretty little aster-like plant known as *Townsendia sericea* Hook. It blooms in early spring, and its pretty, almost sessile, heads of numerous flowers nearly cover the plant itself, so that one sees little more than a compound rosette of yellow and delicate pink close upon the ground.

After blossoming, the bracts of the involucre remain for a considerable time widely opened, but when the achenes are ripe the involucre closes and forces out the mass of achenes, with their abundant long, white pappus and effete corolla tubes. This expulsion was observed



Fig 1

to take place, in one instance, in a plant grown in my laboratory with such force as to suddenly throw the mass of achenes and pappus out free from the involucre. I suppose that the spreading of the pappus has also much to do with freeing the achenial mass from the involucres. Possibly the pappus and involucres act together.

The achenes are pretty well covered with long twisted and bent “duplex” hairs, as is common in this and many allied genera.¹

¹ As shown by Professor Macloskie, in his paper on “Achenial Hairs and Fibres of Compositæ.” *American Naturalist*, Vol. XVII., p. 31; and also “Achenial Hairs of *Townsendia*.” *Ibid.*, p. 1102.

The extremities of the hairs are recurved into double hooks, as shown in the accompanying cut (Fig. 1). The body of the hair (as shown by Macloskie) is composed of two parallel, greatly-elongated cells, each of which is recurved, thus forming the double hook. In some instances I have observed septa in one or other of the cells, although for the most part they are wanting. The hairs upon each achene become interwoven with those of neighboring achenes, and, upon drying and twisting, they firmly bind together all the achenes of each head. The spreading pappus forces the mass to take an ellipsoid form as soon as it has escaped from the involu-

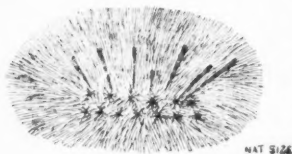


Fig. 2

NAT. SIZE

lucer (as shown in Fig. 2). Lying now upon the surface of the plant, and entirely freed from the embrace of the involucre, the light mass is ready to begin its career as a miniature "tumble-weed." After a few rolls it loses most of the effect of corolla tubes and tumbles lightly along upon the points of its spreading pappus.

The jarring gradually separates the tumbling ball; but even when it breaks in two, each part rounds up again by the wide spreading of the pappus and rolls on again before the brisk breeze of the plains, dropping here and there an achene with its hidden seed, just as the great tumble-weeds, *Amaranthus*, *Cycloloma*, *Corispermum*, etc., do in their larger way.—*Charles E. Bessey*.

UNDERWOOD'S FERNS AND THEIR ALLIES.¹—This little book, the first and second editions of which were noted in the *NATURALIST* at the time of their appearance, has been entirely re-written; and while the general plan of the former editions has not been materially modified, the details have undergone very considerable changes. The present edition contains thirty-four pages more of matter than the last, and this increase is divided between the general matter (which gains nineteen pages) and the systematic portion, which is increased fifteen pages.

This increase in the number of pages is due to the new matter introduced in the general part, consisting mainly of excellent references to the literature of the subject, and in the systematic part to a considerable increase in the number of species. The glossary is also much increased in volume and value.

The book is a most useful and handy one, and will enable the student of the Pteridophytes to obtain an excellent idea of their structure and classification.

¹ Our Native Ferns and Their Allies, with Synoptical Descriptions of the American Pteridophyta north of Mexico. By Lucien M. Underwood, Ph.D., Professor of Biology in Syracuse University. Third Edition, revised. New York: Henry Holt & Co., 1888. 16mo, pp. xi., 156.

We regret that the author did not abandon the term *frond*, which our present knowledge of the comparative anatomy of plants ought to soon render obsolete. *Frond* and *stipe* ought not to be tolerated longer; we should say *leaf* and *petiole*; for a "frond" is only a leaf and a "stipe" is only a petiole.

In the chapter on "The Fern's Place in Nature," the author adopts the term *Spermaphyta* for the flowering plants, and gives an excellent list of systematic works for the different classes of the vegetable kingdom.—*Charles E. Bessey.*

ZOOLOGY.

AMERICAN NEMATOGNATHI.—The peculiar connection between the air-bladder and hearing apparatus of the Nematognathi has received considerable attention from comparative anatomists. *Cetopsis*, the families *Argeidae*, *Loricariidae*, *Callichthyidae*, and *Hypophthalmidae* were said by Johannes Müller and by Valenciennes to be destitute of an air-bladder, and consequently of the auditory ossicles. Reisner, Day, Sagemehl, and Wright have successively proved the presence of an air-bladder encased in bone in all the forms except *Cetopsis*. In connection with a Revision of the South American Nematognathi we have examined *Cetopsis*, and have also made observations on the *Loricariidae*, *Callichthyidae*, *Hypophthalmidae*, *Siluridae*, *Pygidiidae*, and *Bunocephalidae*. *Cetopsis* agrees in general with the *Pygidiidae* (= *Trichomyteridae*). The enclosure of the air-bladder in a bony capsule in the Nematognathi of America instead of being the exception is the rule, modifications of the enclosed air-bladder being the case in all the families but the *Siluridae* and *Bunocephalidae* (= *Aspredinidae*).

A hint as to the method by which the air-bladder was enclosed may be detected by a comparison of *Ageneiosus* and *Hypophthalmus*. In *Hypophthalmus* the air-bladder is half bony, half membranaceous, the bony portion being attached to the modified vertebrae; the whole air-bladder is surrounded above and behind by the lateral processes of the modified vertebrae, below partly by lateral processes of the vertebrae, mostly by the processes connecting the scapula with the basioccipital, anteriorly partly by the expanded scapula. The scapular process in *Hypophthalmus* extends from the basioccipital backward and outward. If now the coalesced vertebrae could be lengthened so as to separate the scapular process from the lateral processes almost the exact conditions would be obtained which are found in *Ageneiosus*. Like *Hypophthalmus*,

the air-bladder of *Ageneiosus* has a bony base, the membranaceous portion being restricted to a membrane stretched across the opening of the bony capsule; the whole air-bladder is likewise surrounded above and behind by the lateral processes of the modified vertebrae and anteriorly partly by the scapula, but the coalesced vertebrae are much longer than in *Hypophthalmus*, and the lateral processes and scapular process are widely separate below.

Many changes in the classification of the Nematognathi have been found necessary. The *Bunocephalidae* (= *Aspredinidae*) usually associated with the *Loricariidae* have no skeletal affinities with that family, being much more nearly related to the *Siluridae*. The genus *Cetopsis*, as before stated, is more closely related to the species of *Pygidiidae* (= *Trichomycteridae*) than to the species of *Doradinae*, with which it has usually been associated. The genera *Heptapterus* and *Nannoglaris*, on the contrary, are closely related to some of the species of Günther's *Pimelodus*, and have no real affinity with the *Pygidiidae*.

Perhaps the most interesting of the South American cat-fishes is *Diplomystes papillosus*, Cuv. and Val. It differs from all other cat-fishes in having a well-developed maxillary bone bearing a band of teeth and forming the sides of the jaw. This species has no barbels excepting one short one on each maxillary. It is nearly related to *Tachisurus Lacépède* (= *Arius*), and in many ways represents a primitive fish; it may be the remnant of the parent cat-fishes formerly distributed more widely over South America, but now crowded by the more specialized forms, out of the waters inhabited by them to Chili, where it has to contend with the species of *Pygidium* only.

The relationships of the American families may be seen from the following key:—

(a) Air-bladder simple or with transverse constrictions (except in *Ageneiosus*) lying free in the abdominal cavity. Mouth terminal; intestines short, arranged in longitudinal folds. Body naked or with a single series of lateral plates; diaphragm membranaceous; dorsal fin short; confined to the abdominal portion of the vertebral column.

(b) Opercle none; adipose fin none; neural spines of the coalesced vertebrae forming a ridge from the occipital to the dorsal fin. Caudal vertebrae greatly compressed; their neural spines expanded.

..... *Bunocephalidae*.

(bb) Opercle well developed and movable; adipose fin normally present; occipital process sometimes forming a bony bridge from occipital to the dorsal plate. Caudal vertebrae normal; the neural spines spine-like..... *Siluridae*.

(aa) Air-bladder rudimentary; one on either side of the coalesced vertebrae, and entirely surrounded by a bony capsule.

(c) Air-bladder capsule formed by the scapula, the process connecting the scapula with the basioccipital and by the lateral processes of the coalesced vertebrae, its external opening bounded by the scapula and lateral processes; adipose fin small; dorsal fin on anterior half of body, over anal; anal long.....*Hypophthalmidæ*.

(cc) Air-bladder capsule formed by the lateral processes of the anterior vertebrae only. No adipose fin; dorsal fin usually on caudal portion of vertebral column; anal short.....*Pygidiidæ*.

(ccc) Air-bladder capsule formed by the skull and transverse processes of anterior vertebrae; diaphragm partly or wholly osseous, formed by the expansion of the clavicle and scapular process. Scapula and its process firmly joined to the skull; gill membranes joined to the isthmus.

(d) Derm naked; mouth inferior; lower lip reverted; teeth bicuspid, in several series.....*Argeidæ*

(dd) Derm with bony plates.

(e) Caudal vertebral compressed, the neural and hæmal spines expanded, forming a continuous ridge above and below. Sides with several series of plates; mouth inferior; lower lip reverted; teeth turned abruptly back above, a single series erect, the intermaxillaries and dentaries box-shaped, filled with numerous depressed relay teeth; intestinal canal coiled. Cavity of air-bladder usually communicating with the exterior at a notch in the posterior margin of temporal plate at beginning of lateral line.....*Loricariidæ*.

(ee) Caudal vertebrae normal, the neural and hæmal spines spine-like and separate. Sides with two series of plates; mouth terminal; lower lip not reverted; teeth villiform; cavity of air-bladder communicating with the exterior by means of a long narrow slit in the temporal plate.....*Callichthyidæ*.

—C. and R. Eigenmann. (*Mus. Compar. Zoölogy, Cambridge, Mass.*)

DESCRIPTION OF A NEW RED-BACKED MOUSE (*EVOTOMYS DAWSONI*) FROM THE HEADWATERS OF LIARD RIVER, NORTH-WEST TERRITORY.—Dr. George M. Dawson, Assistant Director of the Geological and Natural History Survey of Canada, has kindly sent me for determination a red-backed mouse collected by him June 23d, 1887 at Finlayson River, one of the northern sources of Liard River, in lat. $61^{\circ} 30' N.$; long. $129^{\circ} 30' W.$; altitude, 3,000 feet.

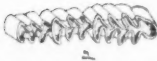
So little is known of the small mammals of this remote and inaccessible region that it is not particularly surprising to find that the mouse collected by Dr. Dawson proves to be undescribed. In some respects it is intermediate between the circumpolar *Evotomys rutilus* and its more southern congener, *Evotomys gapperi*. But since it differs from both and no intermediate forms are known, it must

be regarded as specifically distinct. Hereafter, should intergrades be discovered, it may be necessary to consider it a sub-species. It may be characterized as follows:—

EVOTOMYS DAWSONI sp. nov.

Dawson's Red-backed Mouse.

Type in Museum of Geological and Natural History Survey of Canada, at Ottawa. From Finlayson River, a northern source of Liard River, N. W. T. (lat. $61^{\circ} 30' N.$; long. $129^{\circ} 30' W.$; altitude, 3,000 feet). Size, about equal to that of *Evotomys gapperi*. Measurements from mounted specimen (apparently well mounted and not at all stretched): Head and body, 75 mm.; tail vertebrae, 28 mm.—pencil, 8 mm. (total, 36 mm.); ears, from crown, 7 mm. Tail shorter and thicker than in *gapperi*, but longer and slimmer than in *utilus*, in this respect (but no other) agreeing with a specimen collected at Fort Liard by Kennicott (No. 4,562, U. S. National Museum). The hind foot is intermediate between that of *utilus* and that of *gapperi*, being thicker than in *gapperi*, but not so thick as in *utilus*. The ears conspicuously overtop the fur, fully equalling those of *gapperi*. The tail is bicolor, the yellowish of the under part occupying a little more than half of the circumference. It is well haired, and the terminal pencil is nearly black above (and 8 mm. long). The red dorsal stripe begins just behind the eyes and extends to the root of the tail. In color it is bright chestnut—not far from ferruginous; the sides are tawny gray, and the belly is strongly washed with ochraceous buff. The admixture of black-tipped hairs is as great as in *gapperi* and it is very much more conspicuous, owing to the lighter ground-color of the back and sides. The result is a sort of “peppery” appearance not seen in any other representative of the genus. There is a tolerably well-defined whitish post-auricular spot—an exaggeration of the pale blotch sometimes seen behind the ear in *utilus*. The whiskers are black and white; they reach back to the shoulders, instead of stopping at the occiput, as usual in the genus. A blackish stripe, bordered below with fulvous, runs from the base of the whiskers to the tip of the nose. The projecting margin of the ear is well covered with reddish hairs, brightest on the interior of the auricle.



Molar teeth of *Evotomys dawsoni*, Merriam. 1, right upper molar series; 2, left lower molar series.

Cranial and Dental Characters.—Unfortunately, the skull was badly smashed and part of it altogether wanting; hence no cranial characters can be made out. The teeth, however, remain, and are represented in the accompanying cut. Their most marked peculiarity, compared with

those of *gapperi*, consists in the openly-communicating loops. The upper molar series measures 4.5 mm. on the crowns, 4.8 mm. on the alveolæ. The lower molar series measures 4.4 mm. on the crowns, 4.6 mm. on the alveolæ.

I take great pleasure in bestowing upon this handsome mouse the specific name *dawsoni*, as a slight recognition of the indefatigable zeal of its discoverer, the distinguished explorer and geologist, Dr. Geo. M. Dawson, who has added so much to the fund of knowledge relating to Northwestern Canada.—*C. Hart Merriam*.

ZOOLOGICAL NEWS.—GENERAL.—F. Koenike records (*Abh. Nat. Ver. Bremen.*, X.) the finding of the Myriapod *Geophilus sodalis* in a hen's egg.

PROTOZOA.—Dr. A. C. Stokes gives a generic synopsis of the sedimentary fresh-water peritrichous Infusoria in the *American Monthly Micros. Journal*, IX., p. 59.

CŒLENTERATES.—Dr. Benjamin Sharp records (*Proc. Acad. Nat. Sci.*, Phila., 1888, p. 82) the finding of the common ctenophore, *Mnemiopsis leidyi* in a pond of fresh water in Nantucket. They appeared perfectly healthy and active and were phosphorescent at night. The pond was occasionally opened to the sea to allow the escape of the perch which bred in it; but at the time of the observation the water in which the jelly-fish were swimming was perfectly fresh to the taste.

WORMS.—Dr. Otto Seifert has a paper on the pathological effects of the human parasite, *Ancylostomum duodenale*, in the *Verhandlungen* of the Phys. Med. Gesellschaft, of Würzburg (XXI.). This is the worm which was first brought into prominence at the time of the building of the St. Gothard tunnel, when it produced the disease in the workmen known as Gothard or tunnel disease.

MOLLUSCS.—Dr. W. D. Hartmann communicates to the *Proceedings* of the Philadelphia Academy (1888, pp. 14–56) catalogues of the known species of the genera *Auriculella* and *Achatinella*, of the Hawaiian Islands. The account of the latter genus is prefixed by a *résumé* of our knowledge of the individual variation and the local distribution of the species.

Mr. B. H. Wright describes (*Proc. Acad. Nat. Sci.*, Phila., 1888, p. 113) seven new species of Unionidæ from Florida. Each specific name is dedicated to some friend of the describer.

Dr. E. von Martens describes (*Stzb. Gesellsch. Naturf. Freunde*, Berlin, 1887, p. 106) two new species of Unio (*U. percompressus* and *U. microdon*, from Guatemala.

CRUSTACEA.—Dr. A. Walter describes (*Bull. Soc. Imp. Nat., Moskau, 1887*) two new phyllopods (*Apus haeckelii* and *Artemia asiatica*) from the Russian Transcasian province.

The species of the genus *Podon* are reviewed by Poppe in the *Abhandl. Nat. Verein zu Bremen, Bd. X.* A new species (*P. schmackeri*) is described from Shanghai, China.

C. F. Lutken has a paper on the whale-lice (*Cyamus*) in *Vidensk. Selsk. Skr. Kjobenhaven, IV.* He points out the identity of certain species described by Dall with those of previous authors, and re-describes, with a full-page plate, Dall's *Cyamus scammoni*.

Carl Bovallius, (notes on the family Asellidae, communicated to the Royal Swedish Academy of Science, December 9th, 1885,) makes the family to consist of thirteen genera, three of which, *Iamna*, *Iathrippa* and *Iais*, are new. The two forms of *Iamna* were formerly referred to *Iaera*; *Iathrippa* is formed to receive *Janira longicauda*, while *Iais* includes the new species *I. hargeri* and the *Juera pubescens* of Dana.

ARACHNIDA.—Herr Doenitz describes (*Stzb. Gesellsch. Naturf. Freunde, Berlin, 1887*) the habits of two new trap-door spiders of Japan, belonging to the genera *Atypus* and *Pachylomerus*. *P. fragaria*, unlike the rest of the genus, excavates its tubes in the soft bark of the camphor-trees or of the cypress (*Cryptomeria*) and closes it with a door, which it carefully covers with moss like that covering the rest of the tree. Doenitz also describes (*l.c.*) the copulatory habits of a Japanese species of *Linyphia*.

S. A. Poppe communicates to the *Abhandlungen* (Band X.) of the Scientific Union of Bremen a valuable review of the parasitic mites belonging to the families Sarcoptidae and Chelytidae. The paper contains, among other things, a catalogue of all the known species of bird-mites (*Analgesinae*), arranged according to hosts.

Joseph L. Hancock describes (*Proc. Am. Phil. Soc'y, XXV., 107*) a new species of *Datames* (*D. magna*) from Laredo, Tex.

Dr. H. C. McCook, in a recent visit to London, found the original drawings by John Abbott which formed the basis of Baron Walckenaer's descriptions of the American species of spiders. He gives the results of his studies of these drawings and the conflicts of priority of nomenclature between Hentz and Walckenaer in the *Proceedings* of the Philadelphia Academy (1887, p. 74).

BIRDS.—Mr. F. A. Lucas (*Auk, V.*) gives a historical sketch of Bird Rocks, in the Gulf of St. Lawrence, and describes a recent visit to the place.

Dr. Elliott Coues proposes (*Auk, V., 207*) the term *Corydomorphæ* for a super-family of birds, embracing the larks (*Alaudidae*),

which is distinguished from the other passerine birds by the non-oscine scutelliplanation.

Dr. R. W. Shufeldt continues his studies of the pterylosis of birds by describing the feather tracts (*Auk*, V., 212) of certain of the woodpeckers.

From notes on the fauna of Corea, by H. H. Giglioli and T. Salvadori, as well as from a list of birds collected by M. Kalinowski, and described by L. Taczanowski (*P. Z. S.*, Dec., 1887), it appears that a close affinity exists between the Corean and Japanese faunas. The greatest rarity mentioned by the former authors is *Cyngus davidi*, of which two specimens were obtained. According to M. Kalinowski, Corea is very poor in birds, three-fourths of which are only birds of passage. Only one new species (*Thriponax kalinowskii*) is described, and three others were for the first time found on the Asiatic Continent.

Mr. P. L. Selater describes (*P. Z. S.*, Jan., 1887) ten new species of Tyrannida from various parts of South America.

Mr. K. B. Sharpe (*P. Z. S.*, 1887) describes *Carpophaga whartoni*, a new species of fruit-pigeon from Christmas Island; also, from the same island, a thrush, whose nearest ally is a West African species.

MAMMALS.—The officers of H. M. S. Flying-Fish collected at Christmas Island, a coral island 190 miles from the nearest point of Java, two species of Mammalia, viz.: a new species of Flying-Fox (*Pteropus natalis*), and the large rat *Mus macleari*.

Although the true zebra is now a rare animal, it appears from a letter published in the *Field*, Dec., 1886, by Mr. H. A. Brydon, that it still inhabits the most remote and rugged ranges of Cape Colony, such as the Winterhoek Mountains and the Zwartberg.

W. H. Flower (*P. Z. S.*, Dec. 6th, 1887) denies the right to generic rank of the pigmy Hippopotamus of Liberia, asserting that the greater relative size of the brain cavity, orbits, and auditory bullæ in the Liberian animal, are similar in their nature to those which always occur between the large and small members of the same genus. The characters used to distinguish the genus *Chorropsis*, to which it is referred are, however, dental.

ENTOMOLOGY.¹

SOME OBSERVATIONS ON THE MENTAL POWERS OF SPIDERS.—Under this title an important memoir is published by George W. and Elizabeth G. Peckham,² in which these observers detail numerous experiments upon the senses and mental powers of spiders. The following extracts will serve to indicate the scope of these experiments, and some of the conclusions deduced from them.

"Our experiments on the senses of smell in spiders extended over two summers. Many of them were performed by each of us separately, that we might detect the mistakes of the other. Our usual plan was to hold a slender glass rod, eight inches in length, in such a position that one end closely approached the spider, noting what effect, if any, was produced, and then to dip it into whatever scent we were using, hold it in the same position, and again note the effect. We tested them in this way while at rest in the web, while stalking their prey, while feigning death, and under various other conditions.

"The scents used were essential oils, cologne, and several kinds of perfumes. Acetic acid, vinegar, and like materials were avoided on account of their irritating action upon the integument.

"To sum up our work on the sense of smell, we made, in all, two hundred and twenty experiments. We found three species (*Argyropeira hortorum*, *Dolomedes tenebrosus*, and *Herpyllus ecclesiasticus*) that did not respond to the tests. In all other cases it was evident that the scent was perceived by the spiders. This they showed in different ways,—by various movements of the legs, palpi and abdomen, by shaking their webs, by running away, by seizing the rod and binding it up with web as they would an insect, and in case of the *Attidæ*, by approaching the rod with the first legs and palpi held erect; but whether in the way of attacking it, or, as it sometimes seemed, because the smell was pleasant to them, it is impossible to say."

The most successful experiments upon the sense of hearing were conducted with tuning-forks. "These show that certain spiders indicate that they hear a vibrating tuning-fork by characteristic movements of the legs. Another set of spiders, however, manifest their perception of the sound in a different way. With these

¹ This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

² *Journal of Morphology*, Vol. I., No. 2, pp. 383-419; also published separately by Ginn & Co., Boston.

the approach of a vibrating fork seemed to cause a greater alarm, making them drop from the web and keep out of sight for a longer or shorter time. However, after one of these spiders had been subjected to the experiment several times, it would, instead of dropping, raise its legs in the manner described above.

"A few experiments were made to determine where the organ of hearing was located, but we can offer nothing positive on this question. It seems probable that the auditory apparatus is but little specialized. Possibly it is spread over a considerable portion of the epidermis.

"We endeavored to estimate the strength of the maternal feeling in our spiders by removing their cocoons and then noting with what degree of eagerness they sought to regain them; and also by determining for how long a time they would remember the cocoons if they were separated from them.

"Notwithstanding many efforts, we never found a spider among the Lycosidæ that was constant in her affection for so long a time as forty-eight hours. A female of *Chubiona pallens* Hentz, however, remembered her eggs for this length of time, and when they were returned to her spun a web over them in the corner of the box in which they were placed. Of all the spiders that we experimented upon, the little *Theridium globosum* Hentz had the best memory for her cocoon. We took her from her web, and returned her to it after fifty-one hours. She at once went to the eggs and touched them with her legs. She then left them, to improve her house, every now and then running back to see if they were safe. After she had arranged her household to her satisfaction she settled down near them.

"Several species of Attidæ and Thomisidæ did not remember their cocoons for twenty-four hours; yet these spiders, although they do not carry the egg-sack around with them, remain near it for from fifteen to twenty days."

As bearing on the sense of sight, they state: "We have frequently, while feeding our captives, seen them stalk their prey at a distance of five inches; and we have repeatedly held the active jumping-spider, *Astia vittata*, on one finger, and allowed it to jump on to a finger of the other hand, gradually increasing the distance up to eight inches. As the distance increased the spider paused longer before springing, gathering its legs together to make a good ready.

"We have twice seen a male of this species chasing a female upon a table covered with jars, books and boxes. The female would leap rapidly from one object to another, or would dart over the edge of a book or a box so as to be out of sight. In this position she would remain quiet for a few minutes, and then, creeping to the edge, would peer over to see if the male were still pursuing

her. If he happened not to be hidden she would seem to see him, even when ten or twelve inches away, and would quickly draw back; but in case he was hidden behind some object, she would hurry off, seeming to think she had a chance to escape.

"The male, in the meantime, frequently lost sight of the female. He would then mount to the top of the box or jar upon which he found himself, and, raising his head, would take a comprehensive view of the surrounding objects. Here he would remain until he caught sight of the female,—which he often did at a distance of at least ten inches,—when he would at once leap rapidly after her.

"The ocelli of some spiders, then, enable them to see objects at a distance of at least ten inches."

In order to determine whether spiders have a color sense or not, experiments were tried upon species that were found during the day, running among dead leaves, or hiding under stones or wood. Cages were constructed, each consisting in part of blue, green, yellow and red glass. Spiders were placed in these cages, and the color of the glass beneath which they retreated and remained was noted. The relative positions of the colors were varied on the different experiments. It was found that in two hundred and thirty-seven trials the spiders chose the red one hundred and eighty-one times, the yellow thirty-two, the blue eleven, and the green thirteen. These experiments seem to be conclusive as to the existence of a color sense in certain spiders.

We have not space to quote the results of experiments upon feigning death by spiders, nor to repeat the accounts of mistakes of spiders.

MEETING OF THE ENTOMOLOGICAL CLUB OF THE A. A. A. S.—The next meeting of this club will occur at 9 A.M., August 15th, in the High School building at Cleveland, Ohio.

Owing to the central position of Cleveland, this will be very convenient for the entomologists of both Canada and the United States. We may, therefore, expect a large attendance and a very interesting meeting.

Those who expect to furnish papers should send the titles at once to the Secretary, Professor A. J. Cook, Agricultural College, Mich., so that they may be announced in the programme.

THE ENTOMOLOGICAL REPORTS OF DR. LE BARON.—Professor S. A. Forbes, Champaign, Ill., writes us as follows: "I have lately received from the family of Dr. Le Baron a supply of duplicates of his four reports as State Entomologist of Illinois, 1871-74, and wish to offer, through the *AMERICAN NATURALIST*, to send copies, on receipt of postage, to any one who may wish them to complete their series."

EMBRYOLOGY.¹

RESEARCHES UPON THE DEVELOPMENT OF COMATULA.²—The important and complete observations of Barrois on the development of *Comatula* were made upon materials found at Toulon and Villa-Franca, and kept alive in cribs or boxes anchored in the harbor of Villa-Franca. He records a singular periodicity in the breeding habits of this animal. They deposit several crops of ova during a single season (April), and therefore produce several broods of young which become successively attached to the arms of the parent animals. The development of *Comatula* covers a period of seven days. On the first day oviposition, segmentation, and the formation of the blastula takes place; on the second day the gastrula and blastopore is formed; on the third day the enterocoel, intestine, water-vascular ring, etc., is formed. On the fourth the development of the visceral mass is completed; on the fifth day there occurs the displacement or rotation of the visceral mass, constituting a sort of metamorphosis; on the sixth day the skeleton is formed, and on the seventh hatching occurs.

The following general conclusions are submitted by the author at the close of the memoir — *Fundamental Homologies*. The first and one of the most important results which have been established by the foregoing studies is the proof of the homology between the peduncle of the larva of *Comatula* and the preoral lobe of other Echinoderms, between the calyx of the larvæ of *Comatula* and the body, properly so-called, of the larvæ of other Echinoderms. But, aside from this important homology, the development of *Comatula* differs in two important respects from that of other Echinoderms.

First difference.—In the ordinary Echinoderm-larva (*Asterias*, *Echinus*), the whole of the body, properly so called (the entire body, save the preoral lobe and its appendages), is converted directly without any change of place into a young Echinoderm, so that the latter is found to be inserted at one edge of the preoral lobe. In *Comatula*, on the contrary, we have seen that the body, properly so-called (in other words, the calyx), is pushed towards the extremity of the embryo, so that instead of being, as in other Echinoderms, lodged at one side of the preoral lobe (otherwise the peduncle), it assumes a terminal position. Nevertheless, we also know that if the regular and normal mode of development presents

¹ Edited by Prof. Jno. A. Ryder, Univ. of Penna., Philadelphia.

² Recherches sur le développement de la Comatule. I (*C. mediterranea*), par Dr. Jules Barrois, Directeur du laboratoire de Villefranche. Recueil Zoologique Suisse. IV. No. 4, pp. 545-651, pls. XXV-XXX. Genève-Bale. 1888.

this difference, there is an irregular and abnormal mode of development which does not present it at all, and which, under the condition of the primitive relations of the calyx and of the peduncle, presents the same disposition as in all other Echinoderms; that is to say, that in which the calyx is inserted at one side. We are therefore led to conclude that the difference here noted is not a fundamental one, but that it constitutes a simple alteration of the primitive plan common to all other Echinoderms, resulting from fixation and which disappeared immediately after that fixation ceased to occur.

Second difference. — In the ordinary Echinoderm larva (*Asterias*, *Echinus*), the two peritoneal vesicles maintain their primitive situations, the one at the right and the other at the left, the dorsal face (aboral) of the future Echinoderm being formed at the expense of the portion of the larva which answers to the left peritoneal vesicle. As a result there is a singular discordance between the two faces of the adult and the two faces of the larva, which has been noted by numerous observers, and which consists in this, that the right side of the larva becomes the dorsal face, and the left side of the larva the ventral face of the adult, so that the now outlined Echinoderm is found to be placed in a transverse and a symmetrical position in relation to the preoral lobe of the larva. In Comatula, we have seen, on the contrary, that the ventral and dorsal faces of the larva correspond respectively to the ventral and dorsal faces of the adult in such a manner that the outlined adult (or calyx, in other words), instead of being placed transversely to the peduncle, occupies a symmetrical and regular position in relation to the latter.

We have seen, however, that there is not such a discordance between the positions of the dorsal and ventral aspects of the larva and adult Comatula, and that the two peritoneal sacs here, instead of maintaining their primitive position as in other Echinoderms at the right and left of the embryo, set out on the fifth day, in Comatula, to change their positions, the right sac becoming dorsal, and the left one ventral. Now, if we admit that the formation of the dorsal and ventral faces are subordinated to the position of the peritoneal sacs, we arrive at the conclusion that the displacement of the peritoneal sacs as described above, is a sufficient explanation of the differences noted at the outset.

The paper concludes with further detailed comparisons, which it is difficult to render comprehensible without reference to the original figures. Enough has been noted, however, to show the nature of these newer and more complete results of Barrois, as compared with those of Busch, Thompson, Metschnikoff, Götte and Perrier. The details of development of this most accessible of the crinoids is more fully elaborated in this memoir than in any yet

published, and on that account may be commended to the attention of students.

ON THE DEVELOPMENT OF THE COMMON STURGEON.—Having been requested by the United States Fish Commissioner, Marshall McDonald, to undertake the investigation of the sturgeon (*Acipenser sturio*), I repaired to Delaware City, Delaware, with that object in view. On the 15th of May mature eggs were found in a large female of that species, which was brought in to Mr. Anderson's float. Fortunately a ripe male was encountered at the same time, also in a living condition, from which sufficient milt was obtained for the purpose of fertilizing the eggs. The eggs were quite free in the abdominal cavity, and they ran out in somewhat the way shot would pour out of a rent in a bag, as soon as the abdomen was cut open. The germinal disk was already formed; in fact investigation disclosed the fact that the germinal disk, or area, is developed before the ovum leaves the follicle in which it is matured. Two sorts of ova were found in different individuals. In some the eggs were brownish gray or olive, in other females the eggs were very much darker and contained far more pigment. In all of them, however, the germinal area was clearly defined at one side often with a distinct round dark spot marking its centre, with a paler ring surrounding the central dark area. External to the pale ring there was a distinct dark ring, followed on its external margin by a narrow pale band, from whence the color over the vegetative pole or yolk became uniform. In the darker variety of eggs some of these rings were not so distinct.

During the first hours of development but slight external changes were observed in the form of the germinal area, but by the second day this area had become distinctly oval; the central dark patch was oval and the marginal pigmented ring also oval. The eggs had also changed shape; instead of remaining globular as they were at first, they assumed a slightly oval shape, the long axis of the oval lying parallel to the long axis of the now elongated germinal area. In the course of the third day the oval germinal area had given place to one of somewhat different configuration. Instead of being oval, the germinal area now became decidedly more elongated and rounded at either end, and constricted at the middle, somewhat like the body of a violin. The medullary groove now became visible, and on the third day was distinctly apparent. On the fourth day the head, body and tail of the embryo had been differentiated so far as to project distinctly above the level of the oval yolk sack, the tail was in fact developing as a free, flat lobe. The heart could be seen pulsating within the thin-walled pericardiac space underlying the head at the anterior end of the yolk sack. Hatching took place on the sixth day after fertilization, at which time the body, head and tail of the embryo were densely pigmented and

dark, while the pigment gradually faded out along the sides of the body where the walls of the latter were continued over the yolk sack, leaving the latter quite light beneath, or of a dirty yellow tint.

The eggs of the common sturgeon are very adhesive and must be transferred to trays formed of wire gauze or thin cotton cloth tacked to wooden frames, as soon after fertilization as possible, and spread out in a single layer. If this is not done the eggs will form large masses through which fresh oxygenated water cannot penetrate, and, as a result, those in the centre of the masses will be asphyxiated, fail to develop and become putrescent. The time occupied in handling them after fertilization should not be over twenty minutes. After two or three hours the eggs are firmly adherent to the wire cloth, thin muslin or cheese cloth, and the trays laden with eggs may be placed in running water without fear of detaching any of them, as their mucigen covering has by this time become quite coagulated and gelatinous, forming a coating over the zona radiata of irregular thickness. The zona proper is quite thin and somewhat elastic, but easily broken, so that the eggs are rather delicate in character. There is no "breathing chamber" developed such as is found in the eggs of many Teleosts. The operator must carefully guard against the appearance of fungus.—*John A. Ryder.*

ARCHAEOLOGY AND ANTHROPOLOGY.

TOPINARD ON THE LATEST STEPS IN THE GENEALOGY OF MAN.¹—In this highly interesting lecture M. Topinard examines the evidence as to the later stages of human phylogeny, including those embraced in the series of placental Mammalia. He examines the opinions of previous writers on the subject, referring principally to Hæckel, Vogt, Huxley, and Cope. He commences by a discussion of the systematic relations of the contents of the order Quadrumana of modern authors, commencing with the lemurs. He concludes that in spite of certain well-known peculiarities, the Lemuridae must be included in the same order as the monkeys and man, in opposition to the view of Vogt. He then considers the question as to whether the Anthropoid apes should be arranged with the Old World monkeys or with man, the former being the opinion of Cuvier, Huxley, and Vogt; the latter that of Broca

¹ Les dernières Etages de la Genealogie de l'Homme. Leçon de Mars, 1888; Ecole d'Anthropologie, Paris. Extract du Revue d'Anthropologie, May 1888.

(unpublished) and of the writer of the present review.¹ He decides in favor of the former.

The probability of the origin of man directly from Anthropoid apes, as asserted by Hæckel (monophyletic) and Vogt (polyphyletic), or from Lemurs direct (the opinion advanced by Cope) is then discussed, and M. Topinard concludes that neither hypothesis can be maintained, in view of the structure of the posterior foot. He does not think that the ambulatory hind-foot of man could have been derived from the prehensile hind-foot of the other quadrumana, and he therefore traces the origin of *Homo* to a common type in which the prehensile character of that foot has not yet been developed. This is the genus *Phenacodus*, or some allied form of the *Condylarthra*. He combats successfully the opinion that the monkeys and man have been derived from Ungulates, in the restricted sense in which that term has been used by some authors who have supported that view. But he adopts the view of Cope, that modern Ungulates and Quadrumana had a common origin, which is closely allied to the genus *Phenacodus*.

M. Topinard has understood the teaching of the present writer, in quoting him as believing that man was derived directly from Lemuroids without the intervention of the Anthropoid apes. This is to be inferred not only from the observations I have made on the reversion to the tritubercular or lemuroid type to be found in the superior molar teeth of man, but also from the fact that a generalized type of hind-foot is to be looked for in that family. But it was not necessarily the genus *Anaptomorphus* that possessed all the necessary characters, but rather some other members of the same family. M. Topinard has misunderstood me as believing that *Adapidae* were ancestors of the Ungulates. This I have not said. It is perhaps an appropriate place to give a somewhat fuller synopsis of what appears to me to be the state of the evidence on this question. I have already given the outlines of this phylogeny very briefly in the *NATURALIST* for 1885, and the *Origin of Genera* (1887) in an article on the "Evolution of the Vertebrata, Progressive and Retrogressive."

In the phylogeny of man from the Protozoon, as given by Hæckel, twenty-one stages were enumerated. Our present information compels us to accept all of these except three, and to insert one prior to the Lemuroids, viz., the *Condylarthra*. From the *Condylarthra* of the family *Phenacodontidae* to the *Quadrumana* of the family *Adapidae* the transition is very slight, provided that the latter family is not unguiculate, a point not yet settled. It is also likely that the posterior foot in that family is not prehensile. The opposability of the thumb of the posterior foot is, however, not a character of such importance that it need be much considered in

¹ *American Naturalist*, 1885: "Origin of the Fittest," 1887.

this connection. A very slight modification only of an ambulatory foot would make a prehensile one like that of the Simiidae, and *vice versa*. In any case, whatever may have been the later stages in the phylogeny of *Homo*, we can regard such Lemurs as the Adapidae as in the direct line from the Phenacodontidae.

There is a remarkable resemblance between man and the Anthropoid apes in some parts of their skeleton in which they differ from the monkeys (Cercopithecidae, Cebidae, Hapalidae, and Lemuridae). These characters seem to have been neglected by taxonomic writers. In the first place, the Anthropomorpha (Hominidae and Simiidae) agree in wanting anapophyses of the vertebrae, while the families of monkeys and lemurs, above mentioned, agree with the Carnivora in possessing them. This gives a distinctly different character to the vertebral articulations in the two divisions. In the Anthropomorpha the intertrochlear crest of the humerus is present, while in the other group it is wanting. The same division has the bones of the one carpal series alternating with those of the other, while in the true monkeys these bones are generally opposite. In the one group the os centrale is rarely present; in the other it is always present. On these grounds I proposed to adopt the Anthropomorpha as a division (sub-order) of the order Taxeopoda, of equal value with the Hyracoidea, Condylarthra, Daubentonioidea, and Quadrumana. The form of the terminal phalanges in all of these groups show clearly that the Taxeopoda must be referred to the Ungulata in the large sense in which it was used by Lamarck and his contemporaries when the term was first introduced. In the system as I have adopted it, the Ungulata are those placental Mammalia which are not mutilate, unguiculate, or edentate, or those whose terminal phalanges are flattened in adaptation to support only, and not for prehension. In this view the marmosets (Hapalidae) constitute an anomaly, perhaps not to be included in the order, since they are truly unguiculate. The Hyracidae, on the other hand, show their close affinity with the Quadrumana, not only in their osteology, but also in the structure of their horny nails, which are (except those of the second digits) those of monkeys. These considerations then give the following system of the Taxeopoda:—

Sub-order I. *Hyracoidea*: family Hyracidae.

“ II. *Condylarthra*: families; Peripychidae, Phenacodontidae, Meniscotheriidae.

“ III. *Daubentonioidea*: Chiromyidae; Mixodectidae.

“ IV. *Quadrumana*: Adapidae; Anaptomorphidae; Tarsiidae; Lemuridae; Cebidae; Cerocebidæ.

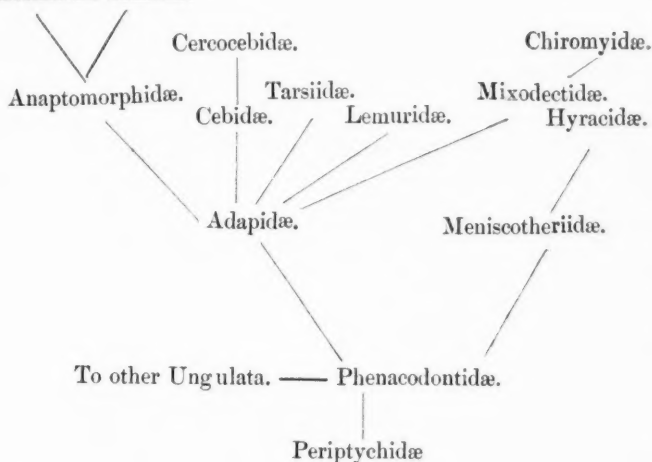
“ V. *Anthropomorpha*; Simiidae; Hominidae.

In the Daubentonioidea (Gill) the incisors grow from persistent pulps. In the Chiromyidae the crowns of the molars are simple,

and there are no canines; in the Mixodectidæ the crowns of the lower molars are quinetubercular, and canines are probably present. In the Quadrumana, Schlosser has shown that in the Lemuridæ the inferior canine teeth are decurved and similar to the incisors, the teeth functioning as such, being the first pre-molars. In the other families of Quadrumana true canines are present in the lower jaw.

From the foregoing considerations the phylogeny of these families will be as follows:—

Hominidæ. Simiidæ.



It may be remarked that the canine teeth in the Adapidæ are of very various development, being incisiform in *Adapis*, small and conic in *Tomtherium*, and large in *Notharctus*. In *Anaptomorphidæ* the canines and incisors are erect, and not decurved as in *Lemuridæ*.—*E. D. Cope*.

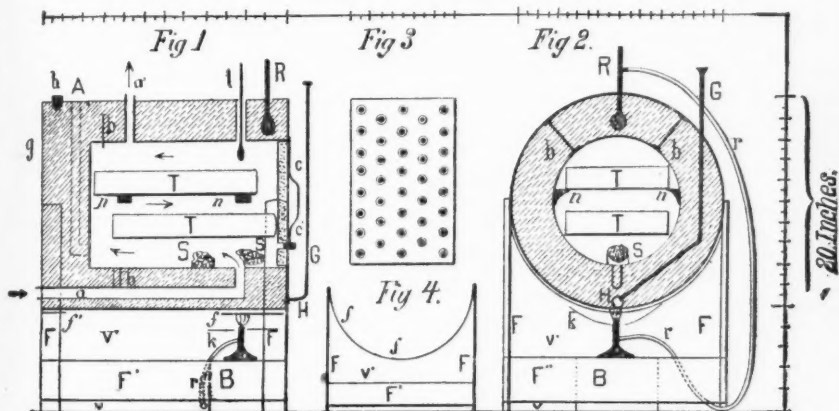
MICROSCOPY.¹

ON FIXING SECTIONS TO THE SLIDE.—Schällibaum's collodion fixative is found to be unreliable when used with the more elaborate micro-chemical reactions to which our advanced technique subjects the sections on the slide before mounting. Thus, sections fixed in this manner drop off in absolute alcohol. *Mayer's albumen fixative* is absolutely reliable, and should be used whenever sections are loosely coherent in their parts. One cannot obtain neat results with this, except by means of a very *even* and thin *film*, to secure which proceed as follows: A small drop of fixative is spread on the slide with the ball of the index finger. Excess of fixative is removed by wiping the finger dry and continuing the rubbing until no frothy streaks appear in the film. Then tap the moist surface lightly with the finger, so that by light reflected at a proper angle it appears pebbled or finely stippled. Each section is pressed into the film with a brush, and when the slide is full a piece of filter-paper is placed over all and firmly pressed with the finger until every part of each section is in even contact with the glass. Then heat the slide *over steam* until the paraffin melts, and then plunge into turpentine. The film is opaque in alcohol, but this is corrected in turpentine and mounting. Should the presence of the foreign albumen in the sections be undesirable, we have recourse to *Gaulé's* alcoholic fixative. This is no fixative in itself, but simply a means by which the albumen molecules of the section are brought into the same adhesive contact with the glass as those of ordinary fixatives. The slide is brushed over with weak alcohol (40–70 per cent.). The stronger alcohols evaporate too rapidly. The sections placed on this film flatten out beautifully and can be shoved about if alcohol enough be present. When the film has evaporated thin the sections stick with great pertinacity. Superfluous alcohol is removed with filter-paper, and the slide must then be evaporated to *dryness*. The thermostat at 40° C., for 1 to 2 hours, is most useful in securing this result. The paraffin should never be allowed to melt. It is removed by turpentine, as for other fixatives. Celloidin sections stick well with this method.—*J. Nelson, J. H. U., Balto., Md.*

A NEW LABORATORY INCUBATOR AND THERMOSTAT.—*Description of Cut:* Fig. 1, plan of longitudinal section; Fig. 2, plan of cross section; Fig. 3, view of egg-pan, from either top or bottom (dark circles are aerating-holes, $\frac{3}{4}$ in. diameter); Fig. 4, end

¹ Edited by C. O. Whitman, Milwaukee.

view of supporting frame, $\frac{1}{24}$ natural size—other figures, $\frac{1}{16}$ natural size. *Explanation of letters:* *a*, inhalent air-tube, 1 in. diameter; *a'*, exhalent air-tube; *B*, block supporting Bunsen burner; *b, b*, braces holding interior drum against upward pressure of the water; *c*, cover fitting into the end of interior drum or brood-chamber; *c'* (placed near lower end of handle of cover), cork-stopper fitting into a thermometer-hole through the cover; *F*, upright pieces of supporting frame; *F'*, *F''*, side and end base-boards of supporting frame; *f*, fire-plate, portion of *f* the supporting belt; *G*, glass



tube fitting through cork in hole; *H*, used as a water-gauge and for emptying reservoir; *h*, opening for filling reservoir; *K*, fire-screen; *n, n*, brackets supporting upper shelf or egg-tray; *R*, regulator; *r*, rubber tube carrying gas from regulator to burner; *s, s*, sponges in cups of water for keeping air moist; *T, T*, egg-trays; *t*, thermometer for brood-chambers; *v', v'*, spaces between uprights of frame covered by sheets of tin; *v*, space below foot-boards for ingress of air, tubing, etc. The tube *A* is not essential, but may be convenient at times, as seen below.

The structure is essentially a water-jacketed bucket, made by fitting a smaller cylinder or drum 16x19 in. inside a larger drum 20 in. in diameter by 24 in depth, thus leaving the space shaded in the cut for water. The cover has a double wall with air space (dotted in Fig. 1). It slips into its place like the cover of a tin pail. With only the tube *A*, and properly supported in the upright position, the gas-flame burning at *g*, the hole *c'* open, and a regulator at *H*, we have the essentials of a laboratory incubator. The air passing through the tube—surrounded by warm water for a considerable distance—is so warmed as not to chill the eggs placed in the brood-

chamber. This was the form devised several years ago by Professor Birge, of Madison, Wisconsin, and because for laboratory purposes comparatively few eggs are needed, and principally the earlier stages of development, we secure an efficient incubator and thermostat at a trifling cost. (Made of sheet-tin, the cost is not over five dollars.)

By modifying this form I have made a more elaborate, but more convenient, machine, which, having successfully stood the test of three seasons' work at the Johns Hopkins Laboratory, I venture to describe. The "drum" was placed in a horizontal position, the tube *a* was added (making *A* superfluous). Apertures *h* and *R* and tubes *a'* and *t* were also added, as shown in the figures. The "drum" was supported by a frame similar to what we get by taking off the top of a table and turning the rest upside down. The legs or uprights at each end were joined by a strip of sheet-iron 2 in. wide, forming a saddle-like belt. The forward end-strip, being cut six inches wide at its middle point, makes a fire-plate for the flame to play on. The point *s* tends to be the coolest; hence the position of the burner. The thermometer *t* should mark the upper limit of the incubation temperature. A sheet of tin is hung by wires, so that the Bunsen burner projects through a hole punched in it, and thus prevents reflection and loss of heat into the surrounding space. The whole structure should rest on a plate of zinc if the floor or table on which it stands is of wood. A coat of paint on the drum reduces radiation and consequent gas-consumption. The eggs are placed in pans 2 inches deep by 10 by 16. Each pan is made of two similar halves that slip one over the other, like the lid of a cardboard box. Thus either side may be up or down, and therefore all the eggs in the pan (forty or more) are turned at once by turning the pan, and, besides, the marks on the eggs are easily inspected. For ordinary thermostat purposes, the trays can be replaced by shelves or drawers. The air circulates in part as indicated by the arrows, with such an arrangement of the pans as shown in the cut, but most of the air passes through the trays directly, and, thus, between the eggs.

If a space be left above the water and the hole *h* be made to connect with an aspirator, on the one hand, and the tube *A* on the other, warm, moist air can be forced into the egg-chamber; but the sponges *s, s*, are practically sufficient. I found by experience that even though the cyclindrical shape is the one giving greatest strength (as well as ease of construction), that zinc is not a good material for this machine to be made from, as it softens under warmth and yields gradually to the pressure. Therefore, if tin be departed from, copper should be chosen; but, of course, this will raise the price.—*J. Nelson.*

SCIENTIFIC NEWS.

—Dr. Roland Duer Irving, Professor of Geology and Mineralogy at the University of Wisconsin, died at Madison on the 30th of May last. Professor Irving was in comparatively good health on the preceding Saturday, having taken a boat ride with his family on one of the lakes surrounding Madison. On Sunday morning about eight o'clock he was stricken with paralysis. During the day he was conscious, but could not be made to realize his serious condition. On Monday he was only half conscious, and from that time gradually passed into a deep stupor, which faded into death on Wednesday morning. Dr. Irving was the chief in charge of the Lake Superior Division of the United States Geological Survey. His most important work was the establishment of a great break in the geological continuity between the Laurentian and the Huronian systems, and (together with President Chamberlin) the erection of a new system, the Keweenawan, between the Huronian and the Cambrian. At the time of his death he was engaged with Professor C. R. Van Hise in the preparation of a monograph on the iron-bearing rocks of the Penokee-Gogebie region. Professor Irving was a native of Staten Island, New York, and was a nephew of Washington Irving. He leaves a wife and three children.

—Henry Carvill Lewis, Professor of Geology at Haverford College and of Mineralogy at the Academy of Natural Sciences, died Saturday at Manchester, England, of typhoid fever. He was in England with his wife and child and intended remaining abroad four or five years. Most of this time was to be spent in Norway studying the geology of that country. He was also to read a paper before the British Association for the Advancement of Science. Prof. Lewis was son of J. Mortimer Lewis and was born in Germantown, Pennsylvania, November 16, 1853. He graduated at the University of Penna., in 1873, and in 1879 served in the State Geological Survey. He was elected Professor of Mineralogy by the Academy of Natural Sciences in 1883 and to the Chair of Geology in Haverford College in 1883. He went to Europe in 1885 and engaged in studying microscopic petrology in the University of Heidelberg. He had charge of the mineralogical department of the *AMERICAN NATURALIST* for a time. Professor Lewis was an enthusiastic student, and a man of most amiable character. His loss is a serious one to the scientific interest of his native city.

—The Boston Biological Laboratory was incorporated in 1888, and is under immediate charge of Director C. O. Whitman, Ph.D., and Instructor B. H. Van Vleck, S.B. It is at Wood's Holl, Massachusetts. A convenient site has been secured close to the shore and to the laboratories of the United States Fish Commission. The Laboratory building consists of two stories: the lower story for the use of students receiving instruction, the upper story exclusively for investigators. The Laboratory has boats, dredges, and other collecting apparatus; it is also supplied with running sea-water, with alcohol, and other reagents, glass-ware, microtomes, aquaria, etc.; a limited number of microscopes for students' use and a small reference library. The Laboratory for Students was opened on Tuesday, July 17th, at 9 A.M., for a systematic course of six weeks in zoology. By permission of the Director students may continue their work until September 20th, without additional payment. Microscopes, glass-ware, etc., are supplied without extra charge except for breakage. The fee for this course is twenty-five dollars (\$25), payable in advance. The Laboratory for Investigators is equipped as fully as the means permit. Microscopes are provided, but it is believed that investigators will find most of their indispensable wants satisfied. The fee for an investigator's table is fifty dollars (\$50) for the present season. Owing to the late day on which the announcements were sent out there are but about half a dozen students present this year in either department.

